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A fully illustrated guide to Post-war Aircraft Carriers

WAR MACHINE

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Post-war Aircraft Carriers

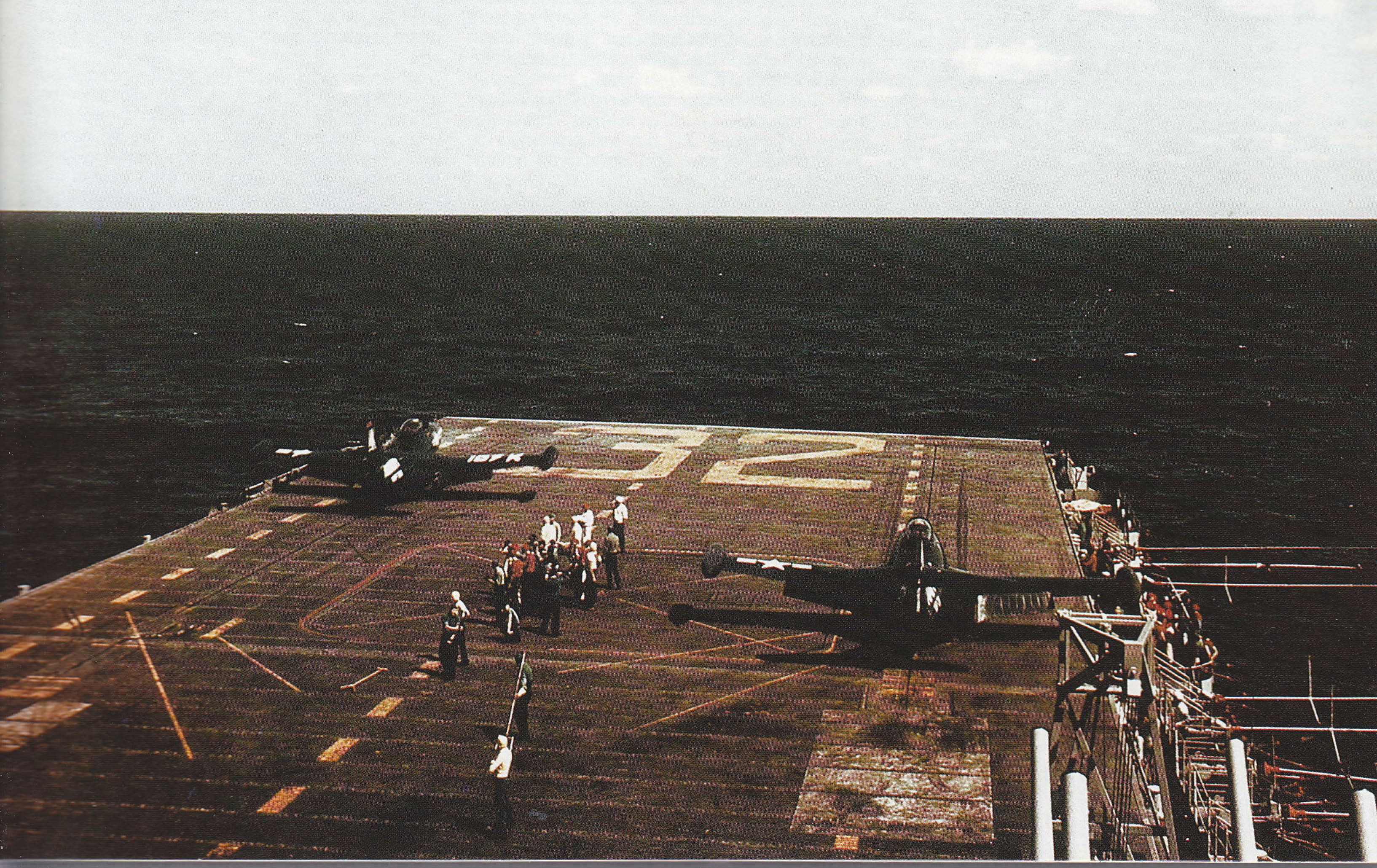
The years following the end of World War II saw the aircraft carrier entering service with more and more navies as the products of the British light carrier programme, surplus to Royal Navy requirements, became available. In the meantime, Britain and the USA had to adapt the enormous post-war advance in aviation to the naval role, which meant that the old carriers were no longer suitable for the changing face of war.

Seen appropriately by the light of the setting sun, Britain's last fleet aircraft-carrier makes her way into history. To the politician Ark Royal *was an anachronism; no longer necessary, given the UK's reduced world position. All the same, she would have been very useful in the Falklands.*

The period immediately after World War II was shaped for aircraft-carriers by the realization that jet aircraft had to be taken to sea. The first landing by the third prototype de Havilland Vampire on the deck of HMS *Ocean* on 3 December 1945 had shown the way forward, but because of the numbers of almost new ships in service the need for jet-capable carriers could be met at first only by rebuilding World War II carriers still on the stocks, or by modernizing those actually in service. The lack of finance for any new building precluded this natural solution to the problem. The rundown of the Royal Navy's carrier force also offered smaller nations the chance to purchase reconditioned vessels for their own navies.

The Korean War then proved to many doubters the value of shipborne tactical air power in the nuclear age, and the navies of the UK and USA maintained a fairly effective force throughout the 1950s and 1960s. However, despite the use of carriers in several overseas crises (such as the Suez operation in 1956 and the Vietnam War of the 1960s), the Labour government of the day in 1966 axed any likelihood of the UK keeping a conventional fixed-wing aircraft-carrier into the latter part of the 20th century by cancelling the new carrier programme. The excuse the government gave was that the only task for which a carrier was indispensable (namely the support of the landing or withdrawal of troops against sophisticated opposition outside the range of land-based air power) would not be undertaken without the help of allies, and that the other roles of carrierborne airpower could be more cheaply performed in other ways. This demonstrated a political naivety beyond belief to many people. One can only wonder what effect a foresight of the 1982 Falklands war would have had on this inept decision, which at a strike effectively destroyed the core of the balanced Royal Navy fleet and its military role within NATO.

The US Navy saw little use for the massive carrier forces built up during the Pacific war, until the war in Korea convinced them otherwise. In spite of being one of the few 'Essex' class not to undergo an SCB modernization, USS Leyte *was able to operate the most up-to-date aircraft of the time in the shape of the Grumman F9F-2 Panther.*



Wars in the Far East

Aircraft carriers have contributed to a number of conflicts since 1945, but the intensity and duration of the involvement was most marked in the two major Far Eastern conflicts – Korea and Vietnam.

An F4U Corsair aboard the 'Essex' class carrier USS Philippine Sea *is loaded with 100-lb (45-kg) bombs in preparation for a strike on North Korean positions. World War II types bore the brunt of early air operations.*

The wars in Korea and Vietnam showed that the aircraft-carrier is a uniquely complex weapon system. At times during the former conflict carriers in fact proved to be the only viable means available to UN forces for the launching of a credible air offensive against enemy supplies, personnel and positions throughout the length and breadth of the Korean peninsula. It was this great tactical value in supporting the land forces ashore that was exploited to the full in the subsequent Vietnam War, where enemy offshore activity was kept to a minimum to provide the carrier forces more or less unrestricted operation along the whole of the Vietnamese coastline.

Although the Korean War started in the early hours of Sunday, 25 June 1950, it was not until 3 July that carriers from the US Navy's Task Force 77 began to launch air strikes. Allocated two airfield targets in an area of north west Korea that included the North Korean capital of Pyongyang, the carriers unleashed a two-day series of attacks that left 10 aircraft damaged on the ground with another two Yakovlevs shot down in air combat. This, coupled with further attacks by the US Air Force, resulted in the halting of the North Korean air offensive for a short period. However, by the middle of the month the air offensive had been renewed with vigour, and another United Nations response was needed. In two strikes by pilots from the task force on 18 July against airfields around Pyongyang 14 communist aircraft were destroyed and 13 more damaged. On the following day the strikes were shifted to the east coast airfields at Yonpo and Sondok, where another 28 aircraft were destroyed. By 20 July the US Navy and US Air Force, with help from the British carrier HMS *Triumph*, had succeeded in accomplishing the first priority of United Nations tactical airpower in Korea, namely the establishment and maintenance of air superiority over the enemy.

Surprisingly it was not until 25 July that the US Navy aircraft began to work in support of the US 8th Army in the field. Shortly afterwards, in early August, the US Marine Corps also entered the close support arena with the US Navy's Task Element 96.23 and the carriers USS *Sicily* and *Badoeng Strait*; these operated two squadrons of Vought F4U Corsair day fighters from a position off the southern coast of Korea in direct support of the 1st Provisional Marine Brigade ashore. Later the US Navy carriers also added the interdiction role to their tasks in an effort to cut off the enemy's front-line formations from their rear-area supply depots.

As the war progressed the US Navy fliers learnt the art of air combat in all its limited-war forms. By October 1952 they had perfected the use of massed fighter-bomber attacks against enemy troop and supply positions near the main line of resistance. Such an attack was known as a 'Cherokee' strike, in which a force of eight F4U Corsairs, eight Douglas AD Skyraiders and between eight and 12 Grumman F9F Panthers would be directed to hit a specific target in the minimum time possible in order to limit aircraft losses and maximize damage.

However, what the Korean War also showed in hindsight to carrierborne airpower was the utility of an effective command and control network to allocate targets for all the air assets available. Because of the lack of such a system at practically all levels in the early part of the war, many naval air strikes were wasted, and even when such a system was established for the latter part there were still lapses.

Tasks for each service

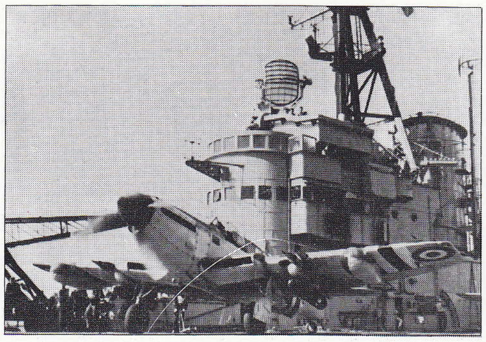
Surprisingly, a decade or so later the same situation was repeated in the early part of the Vietnam War. Although the 'Rolling Thunder' air campaign against North Vietnam was subjected to intolerable interferences from the US government's administration that all but negated its worth, the US Air Force and US Navy still adhered to the concept of assigning specific targets to each service. Luckily the air war planners soon realized their fundamental mistake and refined the targets into a series of 'route packages' which were then allocated to a service as a full-time task. To fulfil its commitments to the overall target coverage, the US Navy designated a geographic point in the northern part of the Gulf of Tonkin as the Task Force 77 carrier operating area known as

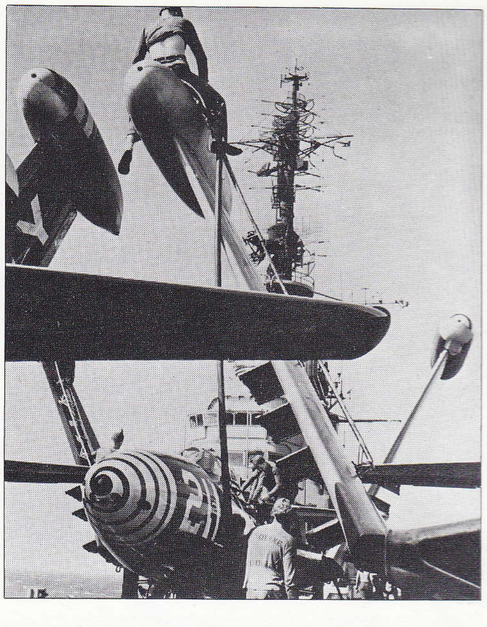
A Douglas AD-4 Skyraider of VA-195 launches from USS Boxer *in 1951, loaded with 500-lb (227-kg) and 265-lb (120-kg) bombs. It was VA-195 which launched the only aerial torpedo attack of the war against the Hwachon Dam.*

'Yankee' Station. Later a second area in the southern part of the gulf, called 'Dixie' Station, was activated for carriers supporting the US Army and Republic of South Vietnam forces fighting the 'in-country' war inside South Vietnam. The latter station also became a 'warming-up' area for newly arrived carriers and their green air groups, so that they could be brought to full operational pitch in the relatively minimum air-defence environment of the skies over South Vietnam. Thus crews adapted to the life associated with continuous combat operations and to the use of live ordnance in combat situations. Once 'conditioned' to this way of life, the carriers were then moved north to 'Yankee' Station, where the air group was used against the integrated North Vietnamese air-defence network which fielded radars, AA guns, SAM missiles and MiG fighters.

Front-line carriers

To service these two operating areas the US Navy needed to keep its carriers on station for periods much longer than was considered normal, and by June 1965 had allocated no less than five of its front-line attack carriers to this task. To breach the air defences (especially the missile barriers) along the various 'route packages', the US Navy developed its own attack methods and armaments. The carriers thus found themselves operating aircraft carrying self-defence jamming pods as well as iron bombs, and missiles such as the AGM-45A Shrike to hit any SAM site located. Specialist ECM aircraft such as the Douglas EA-3B Skywarrior and the Grumman EA-6B Prowler were also deployed over the years to screen the strike forces. Specific SAM-suppression missions were given the name 'Iron Hand', and involved at some stage or other practically all the US Navy fighter and attack aircraft types used in the war.





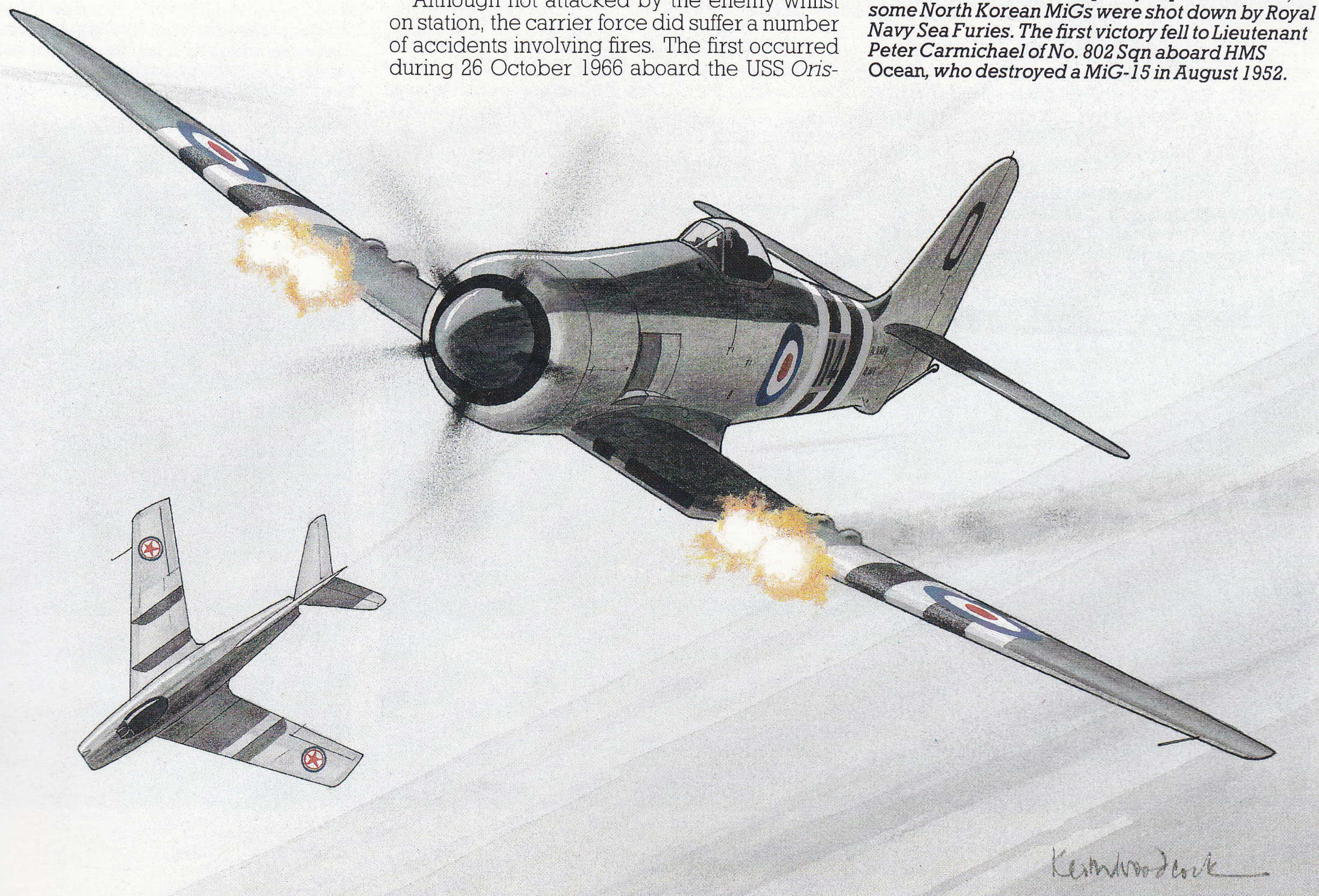
Above: A bombed-up Fairey Firefly of HMAS Sydney *prepares to take off for a strike into Korea. The Australian carrier took station off the east coast of Korea in place of HMS* Glory*, as part of the American-led Task Force 77.*

Right: By the end of the Korean action, jet operations from carrier decks had become commonplace. This Grumman F9F-5 of VF-112 was operating off the modified 'Essex' class carrier USS Kearsage *in 1953.*

In December 1965 a new era of carrier warfare operations was opened when the nuclear powered USS *Enterprise* arrived on 'Yankee' Station with Carrier Air Wing 9 aboard. With two McDonnell F-4B Phantom fighter squadrons, four Douglas A-4C Skyhawk attack squadrons, one heavy PR squadron of Rockwell RA-5C Vigilantes and one tanker squadron of KA-3B Skywarriors (plus detachments of Grumman E-1B Tracer AEW aircraft, Kaman UH-2 utility and SAR helicopters, and RA-3B and EA-3B Skywarrior specialist intelligence-gathering and ECM aircraft) the *Enterprise* quickly began to set new records for numbers of sorties per day and tonnage of bombs dropped.

Although not attacked by the enemy whilst on station, the carrier force did suffer a number of accidents involving fires. The first occurred during 26 October 1966 aboard the USS *Oriskany* when 44 men died, two helicopters were destroyed and four Skyhawks damaged following an accidental explosion of a magnesium parachute flare in Hangar Bay 1. The second was aboard the USS *Forrestal*, detached from the Atlantic for a Vietnam tour: a Zuni rocket accidentally discharged from a Phantom hit a Skyhawk, which exploded in flames and caused loaded ordnance aboard aircraft on the flight deck to explode; by the time that the final fires beneath the flight deck had been brought under control 13 hours later, the *Forrestal*'s air group had effectively been wiped out, with 21 aircraft destroyed and 43 others damaged to

In spite of the marked disparity of performance, some North Korean MiGs were shot down by Royal Navy Sea Furies. The first victory fell to Lieutenant Peter Carmichael of No. 802 Sqn aboard HMS Ocean*, who destroyed a MiG-15 in August 1952.*



While the conflict in Korea was at its height, another carrier force was in action far to the south, off the coast of Indo-China. As a portent of things to come, this American escort carrier, USS Windham Bay*, is seen at Saigon while delivering aircraft to the French in January 1951.*

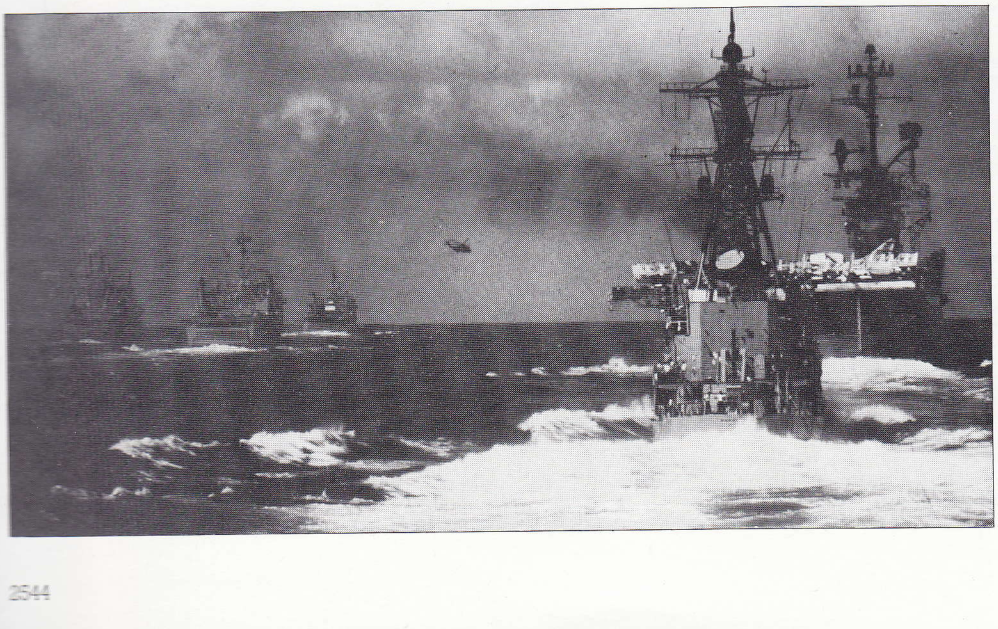
June 1966, and American involvement in the Vietnam war is building in intensity. USS Hancock*, changed out of all recognition from her World War II form, is on station in the South China Sea while launching strikes against North Vietnam.*

varying degrees. In addition 134 of her crew had been killed in the inferno. However, damage below decks was limited by the armoured flight deck. It was the latter that also helped limit damage aboard the *Enterprise* on 14 January 1969 whilst she was preparing to return to Vietnam. Premature ignition of another Zuni rocket caused a three-hour fire and the detonation of several HE bombs on the flight deck. This resulted in a total of 15 aircraft being destroyed, the aft end of the flight deck being severely damaged and 28 men killed. Despite this the ship had been completely repaired when she set sail for Vietnam on 26 June, a testament both to the ship's design features and to the repair yard at Hawaii.

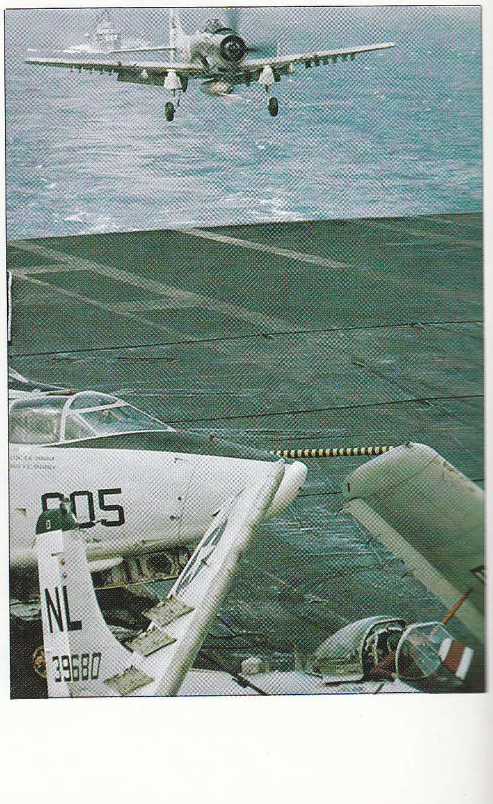
Following the halt to bombing operations over North Vietnam the carriers switched to operations in the south and in Cambodia and Laos until the early part of 1972, when the Easter offensive into South Vietnam by North Vietnamese regular troops and armour called for sterner methods. By July of that year the US Navy had deployed on the two stations six carriers (the *America, Hancock, Kitty Hawk, Midway, Saratoga* and *Oriskany*), with their air groups ranging over the whole of the two Vietnams in an effort to stop the offensive. At the end of the year the carriers provided airfield-suppression strikes and EA-6B Prowler ECM jamming support for USAF Boeing B-52 heavy bombers during the 'Linebacker II' strikes over Hanoi and Haiphong. Following the ceasefire of 23 January 1973, the *Enterprise* began operations in support of the tottering Cambodian government, whilst in April 1975 during the dying days of South Vietnam the carriers *Midway, Enterprise, Coral Sea* and *Hancock* provided air support for the ignominious evacuation of the Americans and some allies from Saigon, the South Vietnamese capital.

The final postscript to the war in Indo-China was written in May 1975, when Kampuchean (Cambodian) communist gunboats seized the American merchant ship *Mayaguez*. The carrier *Coral Sea* launched air strikes in conjunction with US Air Force aircraft on Kampuchean airfields and Koh Tang island to help secure the release of the crew. Ironically, American involvement in the area had ended more or less as it had begun 11 years before, with an attack on an American ship and the subsequent use of carrierborne aircraft.

USS Bon Homme Richard *and escort sail in company with an amphibious squadron as they make their way from the Tonkin Gulf to the major US Navy facility at Yokosuka in Japan, following the end of her last tour of duty off Vietnam.*



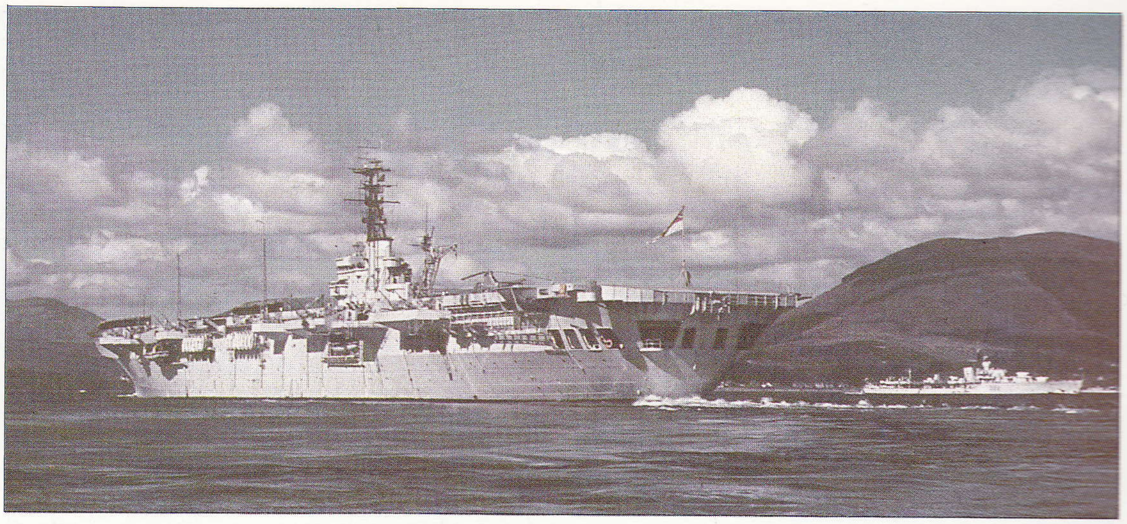
A destroyer stands plane guard off the stern of the 'Midway' class carrier USS Coral Sea*, as an A-1 Skyraider attack aircraft comes in for recovery in January 1968. Navy aircraft regularly operated over the North, as well as in support of US forces in the South.*



UK

HMS *Victorious*

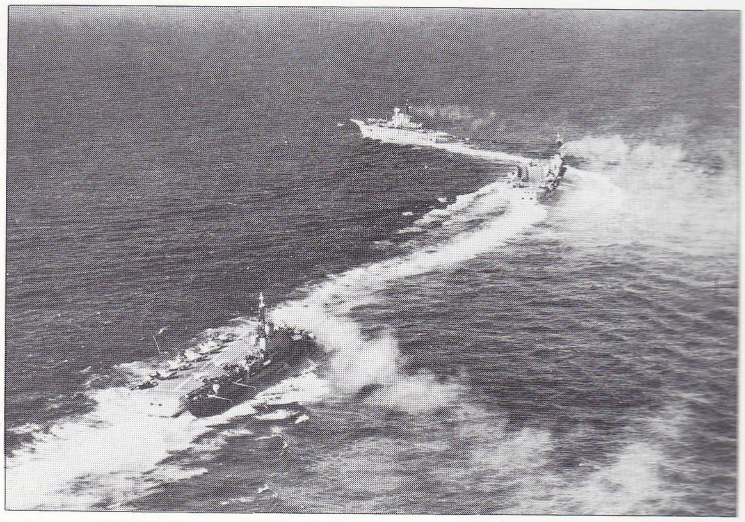
After serving in World War II, HMS ***Victorious*** (R38) was completely rebuilt from the hangar deck up between 1950 and 1957 at Portmouth Dockyard. During this modernization the hull was widened, deepened and lengthened whilst the machinery and boilers were completely renewed. Two steam catapults, new arrester gear and an 8.75° angled flight deck with mirror landing sights (as well as new aircraft lifts and radars) were fitted. A maximum of 35 fixed-wing aircraft were scheduled as the air group, but in the event the *Victorious* never had more than 28 aboard plus eight helicopters. She was again refitted in 1962 and 1968, but before the latter was finished a minor fire broke out, which was taken by the government of the day as an excuse for scrapping her in the following year as part of the 1966 carrier run down programme. The final air group composition carried by the ship was eight Blackburn Buccaneer S.Mk 1 strike aircraft, eight de Havilland Sea Vixen fighters, two Fairey Gannet AEW.Mk 3s and five Westland Wessex helicopters. As one of the fleet's and NATO's strike carrier units, the ship and her Buccaneers were fitted to carry the naval version of the 5/20-kiloton variable-yield 'Red Beard' tactical nuclear gravity bomb.



HMS Victorious *was the only wartime fleet carrier to be thoroughly modernized in the 1950s. Seen here just before the start of her protracted refit, she was to emerge after eight years completely rebuilt from the hangar deck up, and able to operate jets of up to 18145 kg (40,000 lb).*

Specification

HMS *Victorious*
Displacement: 30,500 tons standard and 35,500 tons full load
Dimensions: length 238.0 m (781.0 ft); beam 31.5 m (103.5 ft); draught 9.4 m (31.0 ft); flight deck width 47.8 m (157.0 ft)
Propulsion: three-shaft geared steam turbines delivering 82027 kW (110,000 shp)
Speed: 31 kts
Armament: six twin 76-mm (3-in) Mk 33 AA and one sextuple 40-mm AA gun
Aircraft: 35 (see text)
Complement: 2,400
Electronics: one Type 984 3D radar, one Type 293Q height-finding radar, one Type 974 surface-search radar and one CCA aircraft landing aid

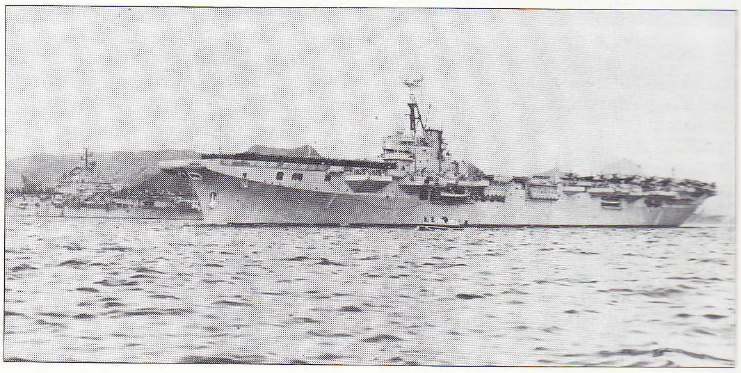


Three of the Royal Navy's four angled deck carriers of the time are seen in this 1960 photograph, only HMS Eagle *being absent.* Victorious, *here seen astern of* Hermes *and* Ark Royal, *was a very different vessel from the carrier that attacked the* Bismarck.

UK

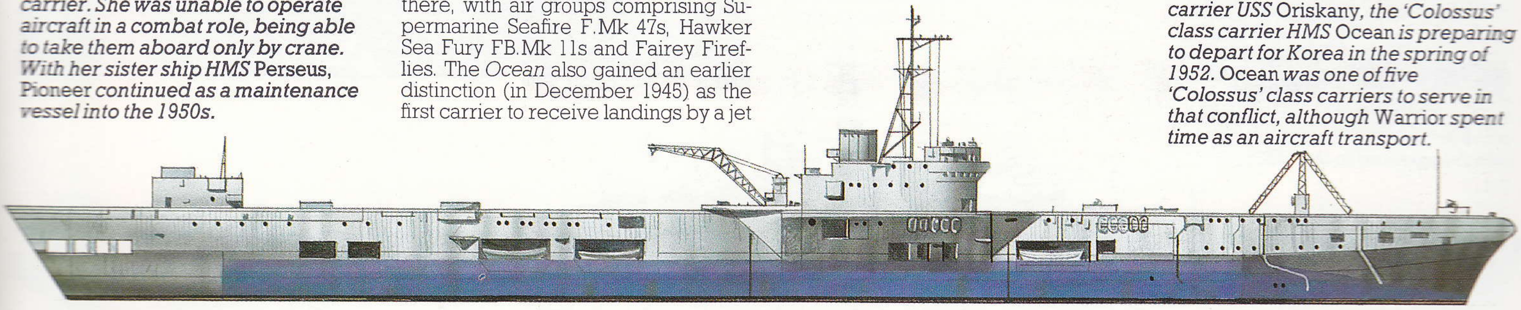
'Colossus' class

The **'Colossus' class** of light fleet carrier was a World War II design that resembled in many ways a scaled-down 'Illustrious' class fleet carrier but with a single hangar, no armour and only light self-defence AA guns. The machinery fit was essentially a modified version of that fitted to contemporary cruisers, but with the boilers and engine rooms set one after the other to reduce the effects of a bomb or torpedo hit below decks. Of the 10 units built most served in the Royal Navy in the post-war years. HMS ***Colossus*** was loaned to the French navy as the ***Arromanches*** in 1946 and was eventually sold to France, whilst HMS ***Pioneer*** (R76) and ***Perseus*** (R51) were completed as aircraft maintenance ships, continuing in these roles until scrapped in 1954 and 1958 respectively. Of the remainder, HMS ***Venerable*** (R81) was sold to the Dutch as the *Karel Doorman* in 1948, whilst HMS ***Warrior*** (R31) was lent to the Royal Canadian Navy and then recommissioned into the Royal Navy before being sold to Argentina in 1958 as the *Independencia.* HMS ***Vengeance*** (R71) was also lent, in this instance to the Royal Australian Navy between 1952 and 1955, before being placed in reserve and then sold to Brazil in 1957 as the *Minas Gerais.* The other four, namely HMS ***Glory*** (R62), ***Ocean*** (R68), ***Theseus*** (R64) and ***Triumph*** (R16), served combat tours off Korea during the war there, with air groups comprising Supermarine Seafire F.Mk 47s, Hawker Sea Fury FB.Mk 11s and Fairey Fireflies. The *Ocean* also gained an earlier distinction (in December 1945) as the first carrier to receive landings by a jet



Above: Seen at Sasebo in company with the American 'Essex' class carrier USS Oriskany, *the 'Colossus' class carrier HMS* Ocean *is preparing to depart for Korea in the spring of 1952.* Ocean *was one of five 'Colossus' class carriers to serve in that conflict, although* Warrior *spent time as an aircraft transport.*

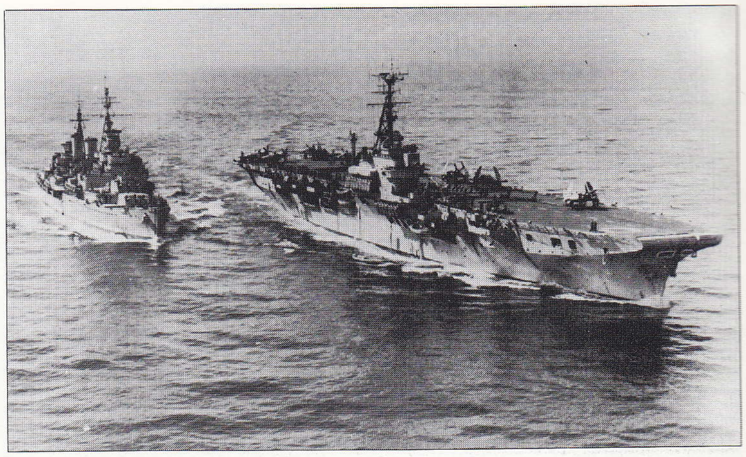
HMS Pioneer *is seen as she was completed in 1945 as a maintenance carrier. She was unable to operate aircraft in a combat role, being able to take them aboard only by crane. With her sister ship HMS* Perseus, Pioneer *continued as a maintenance vessel into the 1950s.*



aircraft. The *Glory*, *Ocean* and *Theseus* were all scrapped in 1961-2, whilst the *Triumph* was converted over a seven-year period to a heavy repair ship. She took part in the Beira patrol in the 1960s and was placed in reserve in 1975, eventually being scrapped in 1981-2 just before the Falklands war where her services were most needed.

Specification

'Colossus' class
Displacement: 13,190 tons standard and 18,040 tons full load
Dimensions: length 211.84 m (695.0 ft); beam 24.38 ft (80.0 ft); draught 7.16 m (23.5 ft); flight deck width 24.38 m (80.0 ft)
Propulsion: two-shaft geared steam turbines delivering 29828 kW (40,000 shp)
Speed: 25 kts
Aircraft: 48
Aircraft: early units 24 2-pdr and from 38 to 60 20-mm guns; later units 17 40-mm guns; maintenance carriers 16 2-pdr and two 20-mm (later 40-mm) guns
Electronics: one type 281 air-search radar, and later fitted with one Type 277 height-finding radar and one Type 293 surface-search radar



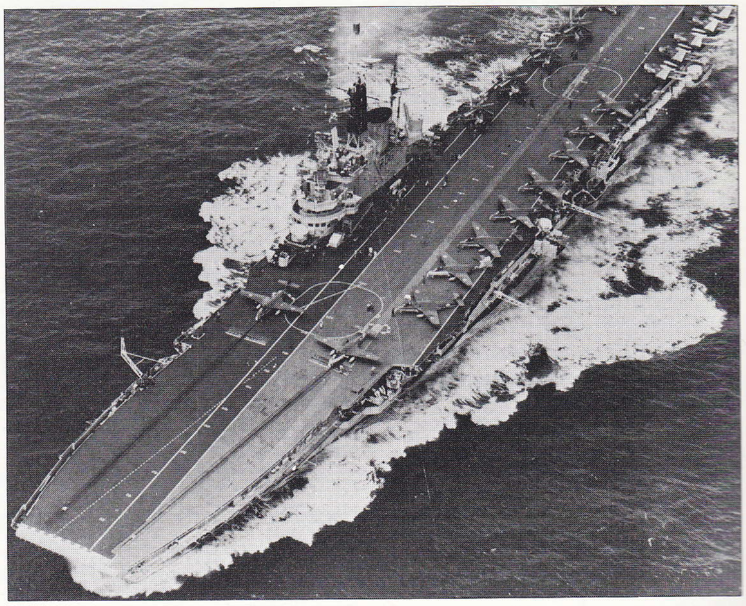
HMS Ocean *in company with the cruiser HMS* Belfast *off Korea.* Ocean *has a considerable claim to fame: she provided the flight deck for the world's first jet carrier landing, when the third prototype de Havilland Vampire made it on 3 December 1945.*

UK

HMS *Centaur*

The history of HMS **Centaur** (R06) rested in the **'Hermes' class** of eight carriers that began life on the design boards in 1943 as ships similar to the 'Colossus' class but with significantly improved capabilities. Following the end of World War II four of those ships already laid down were retained on the stocks for the new post-war fleet. Three of the ships were completed to a modified design incorporating as many wartime lessons as possible. These three were the *Centaur*, *Albion* and *Bulwark*, which were launched in 1947-8 for completion over the next six years. In fact the **Centaur** was completed to a slightly less capable state than the other two as she had only a 5° line painted along her landing area to simulate an angled flight deck. The air group was projected as 16 Hawker Sea Hawks, 16 Fairey Fireflies and four Grumman TBM Avenger AEW aircraft.

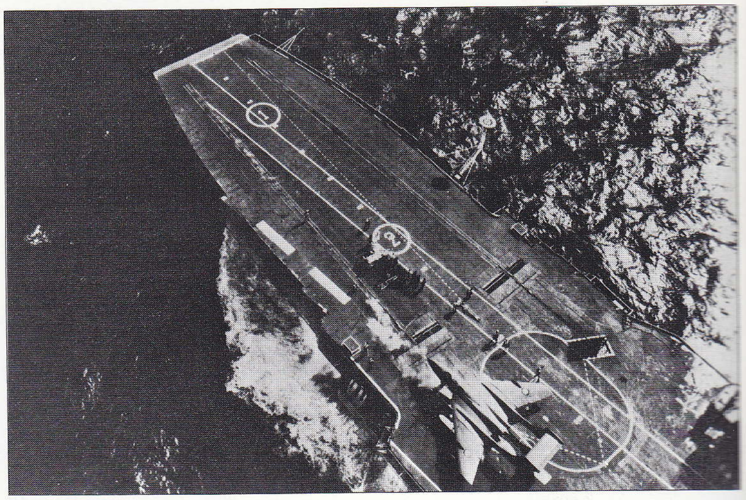
In the late 1950s the *Centaur* received a pair of steam catapaults, but it soon became apparent that she and her near sisters were too small to operate the new generation of aircraft coming into service with the Fleet Air Arm. During her career she served mainly in the Mediterranean and the Far East, including support duties for the army off Aden. By 1966 she had been relegated to the role of a depot ship and was stricken in 1971, the scrapping process starting in the following year. Her final air group comprised 21 fixed-wing aircraft including de Havilland Sea Vixen fighters, Supermarine Scimitar fighter-bombers and Fairey Gannet AEW aircraft. Eight Westland Whirlwind helicopters were also embarked for ASW and SAR duties.



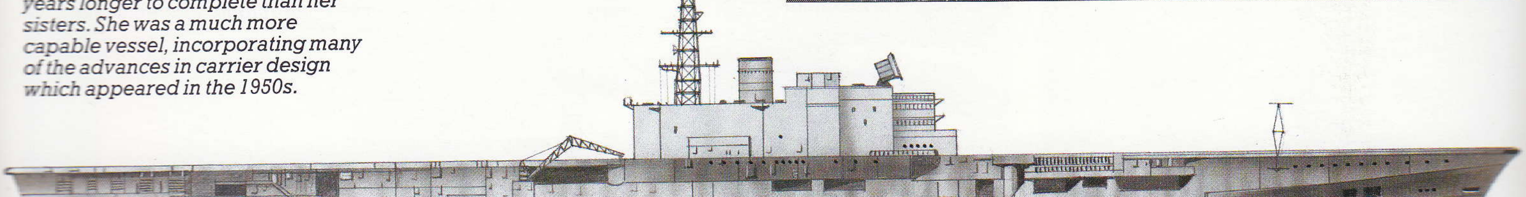
HMS Centaur *as seen in the late 1950s with a good proportion of her air complement topside. She had a 5° angled deck painted on to her straight-through flight deck, but was never converted to the fully angled deck of the larger carriers.*

Specification

HMS *Centaur*
Displacement: 22,000 tons standard and 27,000 tons full load
Dimensions: length 224.64 m (737.0 ft); beam 27.43 m (90.0 ft); draught 8.23 m (27.0 ft); flight deck width 30.48 m (100.0 ft)
Propulsion: two-shaft geared steam turbines delivering 58165 kW (78,000 shp)
Speed: 29.5 kts
Armament: originally 32 40-mm AA guns (two sextuple, eight twin and four single mountings), then 20 40-mm AA guns (eight twin and four single mountings)
Aircraft: originally 42 then 29 (see text)
Complement: 1,390
Electronics: one Type 982 air-search radar, one Type 960 air-search radar, one Type 983 height-finding radar, one Type 277Q fighter-direction radar, one Type 974 navigation radar and one Type 275 fire-control radar



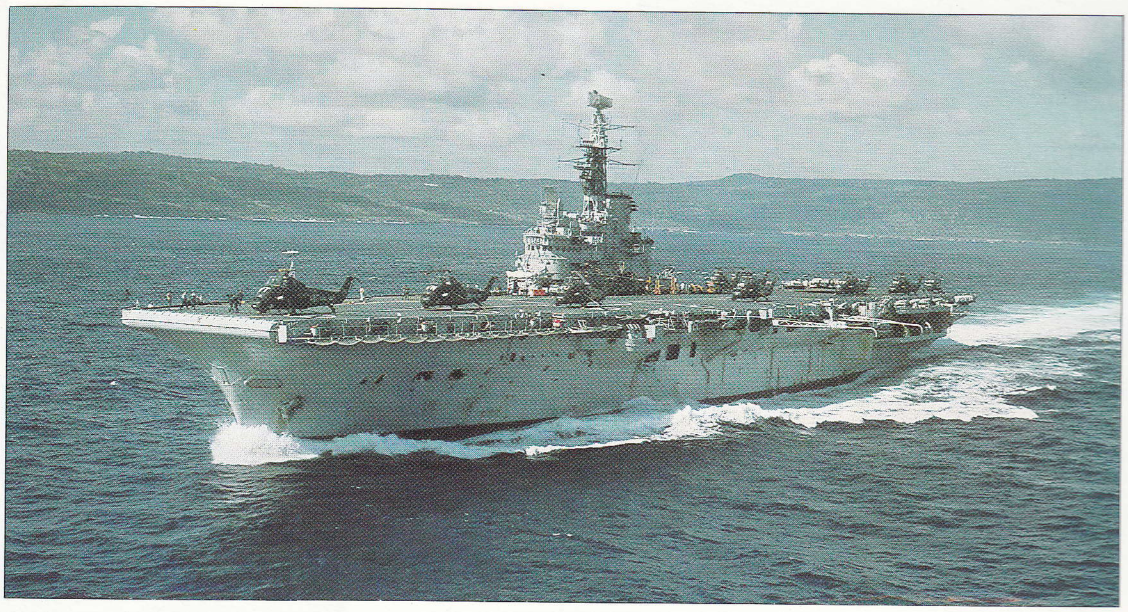
Right: A de Havilland Sea Vixen is launched from one of the newly fitted steam catapults aboard HMS Centaur. *Along with* Victorious, *she was used for service trials of the aircraft in November 1958, and her final aircraft complement was to include Sea Vixens alongside Scimitars and Gannets.*



HMS Hermes, *as she appeared in the mid-1960s, was the culmination of the 'Centaur' class, taking some five years longer to complete than her sisters. She was a much more capable vessel, incorporating many of the advances in carrier design which appeared in the 1950s.*

UK

HMS *Albion* and *Bulwark*



Above: After service in the Far East in the waters off Borneo, Albion *was detached to provide commando facilities in the withdrawal from Aden. Along with* Bulwark, Albion *was in reserve at the start of the 1970s, but was scrapped in 1972. Needless to say, either vessel could have proved valuable in the Falklands in 1982.*

Although sisters of HMS *Centaur*, HMS **Albion** (R07) and **Bulwark** (R08) were completed with an interim 5.75° angled flight deck and two hydraulic catapults. The new flight deck required the removal of three of the twin 40-mm Bofors mountings from the port side in order to accommodate the overhang. Thus built, the two ships served as part of the British carrier force employed in the 1956 Suez Canal landings. The *Albion* served as a fighter carrier with Hawker Sea Hawk and de Havilland Sea Venom jets plus Douglas Skyraider AEW planes and Bristol Sycamore utility/SAR helicopters, whilst the *Bulwark* had Sea Hawks and Grumman TBM-3 Avenger ASW/bomber aircraft.

However, following the success of the carriers HMS *Ocean* and HMS *Theseus* in the helicopter assault role during this operation, and because of the difficulties for this class in operating the new jet generation, it was decided to convert the *Bulwark* to a Commando carrier. This task was undertaken between January 1959 and January 1960, and resulted in removal of the catapults, arrester gear and most of the AA guns. Facilities for carrying a 733-man Royal Marine Commando were fitted, as well as the equipment necessary for an air group of up to 16 Westland Whirlwind helicopters and davits for four LCVPs. Although the refit was for the Commando role, the *Bulwark* also retained an ASW capability.

During 1961-2 the *Albion* was similarly converted, but for 900 Commandos and 16 Westland Wessex helicopters. This capability was retrofitted to the *Bulwark* during 1963. The *Albion*'s Commando career was mainly in the Far East, and she was present during the 1966 Indonesian confrontation and the subsequent Aden withdrawal. Immediately following this she was placed in reserve and was finally stricken from the fleet in 1972 and broken up. In the meantime, the *Bulwark* served in the Mediterranean and the Far East as a Commando carrier, and was also on duty during the Indonesian and Aden crises. Placed in reserve in 1976, she was refitted in 1977 to act as an interim ASW carrier and recommissioned in 1979 to release HMS *Hermes* from the amphibious warfare role. With the advent of HMS *Invincible* in 1980 she was again relegated to the reserve and paid off in 1981 for disposal. The 1982 Falklands War saw the possibility of her recommissioning yet again for active service, but following a survey she was found to be in such a bad state that the idea was quickly dropped and she was eventually sold for scrap and broken up in 1984.

Specification

HMS *Albion* and **HMS *Bulwark*** (as commando carriers)
Displacement: 22,300 tons standard and 27,705 tons full load
Dimensions: length 224.9 m (737.8 ft); beam 27.4 m (90.0 ft); draught 8.5 m (28.0 ft); flight deck width 37.6 m (123.5 ft)
Propulsion: two-shaft geared steam turbines delivering 58,165 kW (78,000 shp)
Armament: (*Albion*) four single 40-mm AA or (*Bulwark*) three twin, and two single 40-mm AA guns
Aircraft: 20 helicopters
Electronics: one Type 965 air-search radar (*Albion*) or Type 982 air-search radar (*Bulwark*), one Type 293 air-search radar (both), one Type 983 height-finding radar (*Albion*), one type 974 navigation radar (both) and one Type 275 fire-control radar (both)

Two Wessex Mk 5 helicopters make an approach to the commando carrier HMS Albion *after her 1965 refit.* Albion *spent much of her commando career in the Far East, and within months of this photograph she was involved with the Indonesian confrontation.*

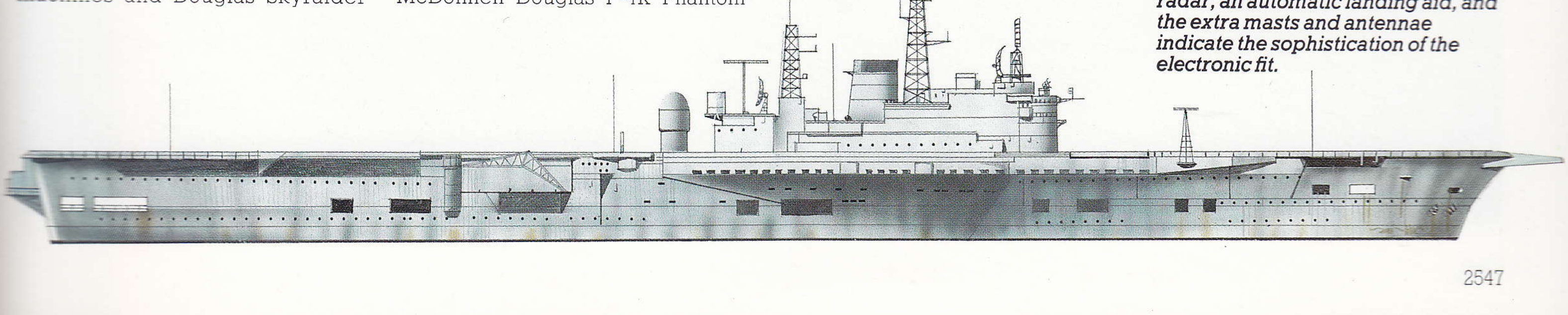
UK

HMS *Ark Royal*

Near sister of HMS *Eagle*, HMS **Ark Royal** (R09) was completed in 1955 to a more modern configuration with a pair of steam catapaults, a 5.5° angled flight deck, a mirror landing sight and a port-side deck-edge lift serving the upper hangar only. Her first air group capacity was 50 aircraft, comprising Hawker Sea Hawks, Fairey Gannet ASW machines and Douglas Skyraider AEW types plus several utility helicopters. In 1956 the ship's starboard 114-mm (4.5-in) turrets were removed, and in 1959 the deck-edge lift went. In 1964 the forward pairs of the aft 114-mm guns were removed, whilst the remaining turrets and the last 40-mm Bofors went during the 1967-70 refit. This was to allow for the operation of McDonnell Douglas F-4K Phantom fighters. An 8.5° flight deck was fitted, together with new catapults (including a new waist one) and arrester gear. The island was also reconfigured, and the addition of new radars was complemented by the improvement of the older types.

The air group capacity dropped from 48 to 39, a figure which stayed constant for the remainder of the ship's

The profile of HMS Ark Royal *in 1978 presents a number of features very different to the vessel of the 1950s. The dome abaft the island covers the CCA (Carrier Controlled Approach) radar, an automatic landing aid, and the extra masts and antennae indicate the sophistication of the electronic fit.*

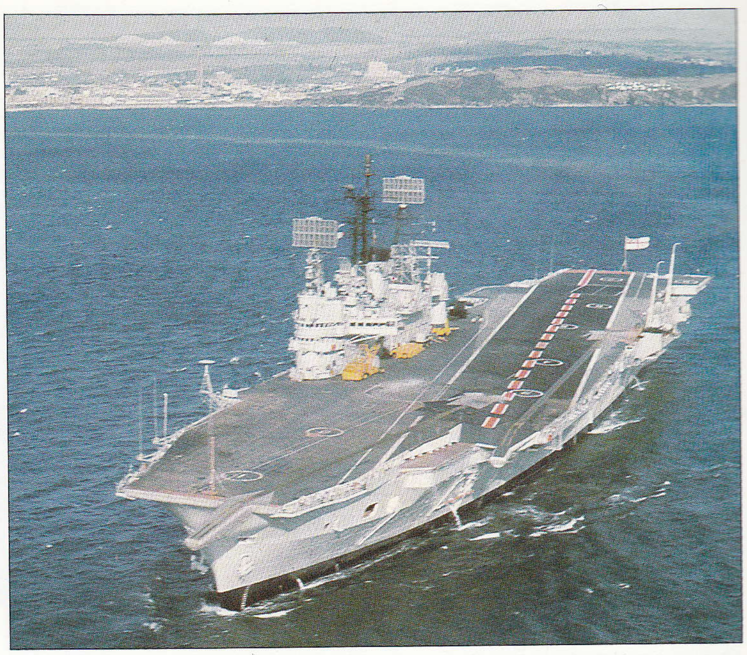


active career. Typically this was 12 Phantom FG.Mk 1s, 14 Blackburn Buccaneer S.Mk 2s, four Gannet AEW.Mk 3s, six Westland Sea King HAS.Mk 1 (later HAS.Mk 2) ASW helicopters, two Westland Wessex Mk 1 SAR helicopters and a converted Gannet ASW carrier onboard delivery plane. The Buccaneers doubled as tanker aircraft with buddy inflight-refuelling pods and as long-range photo-reconnaissance aircraft with a bomb bay-mounted camera pack, at least one Buccaneer being configured in the latter role at all times.

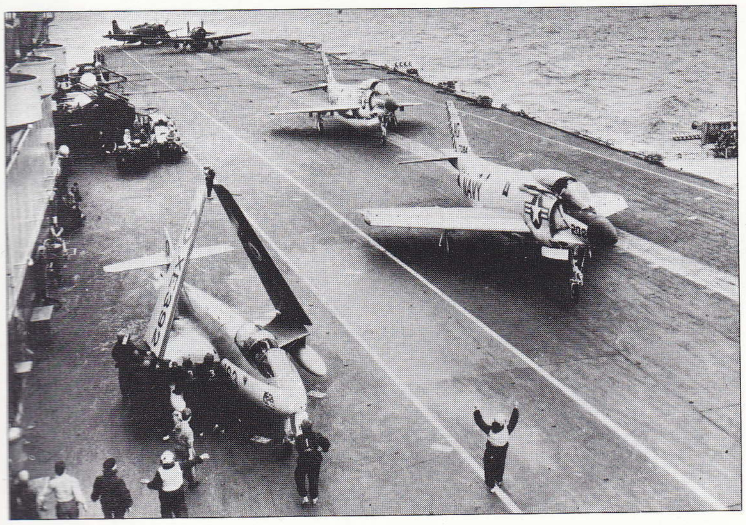
Although suffering throughout her life from mechanical problems, the *Ark Royal* eventually was taken out of service in 1978 as the last of the Royal Navy's conventional carriers. After much public debate as to her future she was finally towed away from Devonport in 1980 for scrapping. Like her sister ship she was fitted to carry in the 1960s 'Red Beard' and later 'Green Parrot' tactical nuclear bombs.

Specification

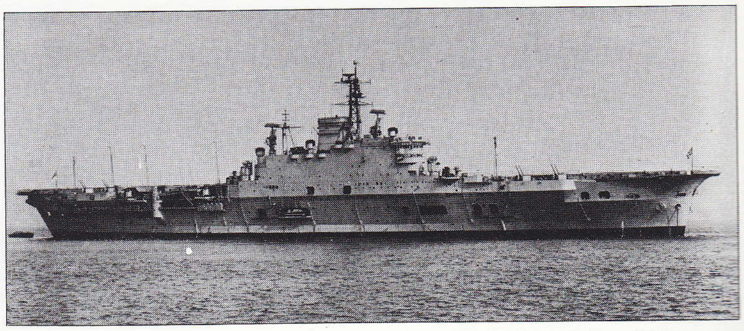
HMS Ark Royal (last commission)
Displacement: 43,060 tons standard and 50,786 tons full load
Dimensions: length 275.6 m (845.0 ft); beam 34.4 m (112.8 ft); draught 11.0m (36.0 ft); flight deck width 50.1 m (164.5 ft)
Propulsion: four-shaft geared steam turbines delivering 113346 kW (152,000 shp)
Speed: 31.5 kts
Aircraft: 39 (see text)
Armament: none, but fitted for four quadruple GWS22 Sea Cat SAM launchers
Complement: 2,637
Electronics: two Type 965M air-search radars, two Type 982 air-search radars, two Type 983 height-finding radars, one Type 993 surface-search radar, one SPN-35 aircraft landing aid, one Type 974 navigation radar and one ESM system



Right: Bearer of an honourable name dating back to the Armada, the Ark Royal ended her career in the 1970s operating F-4 Phantoms and Buccaneers, and in spite of mechanical problems she was one of the most powerful vessels in the world.



Left: In October 1957 operating with the USS** Saratoga **enabled Ark Royal to play host to McDonnell F3H Demon fighters of VF-61. The Seahawk is preparing for launch after the Demons, and in the background two AEW Skyraiders are ranged ready for a free take-off.



Above: As completed in 1955, HMS** Ark Royal **had a heavy gun armament comprising 16 4.5-in (114-mm) and a number of 40-mm AA guns. Her air group of 50 aircraft was to include Sea Hawks, Gannets, Skyraiders and helicopters.

UK

HMS *Eagle*

Originally to be named HMS ***Audacious***, one of a class of four **'Improved Implacable' class** fleet carriers, this hull was fairly advanced at the end of World War II and was therefore chosen to be completed more or less as designed. In January 1946 the name was changed to *Eagle* (R06), but the completion of a surviving sistership, HMS *Ark Royal*, was held up to allow the incorporation of numerous improvements. Completed in 1951 the *Eagle* had, in comparison with the original design, a reduced armament of eight twin 114-mm (4.5-in) DP guns, and eight sextuple, two twin and nine single 40-mm Bofors AA guns, more advanced search radars and a grand total of 12 American Mk 37 radar gun directors. An air group of Blackburn Firebrand strike fighters and Supermarine Attacker jets was embarked. A total of 60 fixed-wing aircraft could be carried, although in 1954 the number was 59 Hawker Sea Hawks, Grumman Avengers, Douglas Skyraider AEW aircraft and one Westland Dragonfly SAR helicopter.

From mid-1954 to early 1955 the ship underwent her modernization refit that resulted in the building of a 5.5° angled flight deck, the fitting of a mirror landing sight and the removal of three single and one sextuple Bofors mounts. In 1956 the ship served as part of the Anglo-French carrier force during the Suez landings, operating a mixed air group of Sea Hawks, Westland Wyverns and de Havilland Sea Venoms on strike missions. From mid-1959 to mid-1964 the *Eagle* was taken in hand at Devonport Dockyard for a complete rebuild in which all the forward 114-mm mounts and all the 40-mm guns were removed, an 8.5° flight deck was fitted, the radar outfit was modernized, and six quadruple Sea Cat close-range SAM launchers were fitted. The air group number was reduced to 35 fixed-wing and 10 rotary-wing aircraft, this complement being made up of Sea Vixens, Supermarine Scimitars, Fairey Gannets and Westland Wessexes.

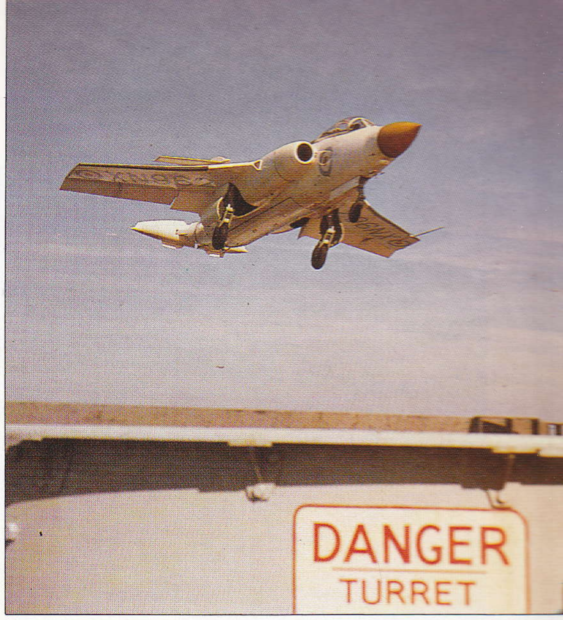
In 1964 the ship sailed for the Far East and the Indonesian confrontation, which was followed in 1966 by Rhodesia and the Beira patrol to prevent oil reaching the rebel country through Mozambique. In 1967 she moved on to Aden to cover the British withdrawal from that troubled area. It was during a refit between these operations that the *Eagle* was fitted to carry Blackburn Buccaneers and had a waist catapult added. Following a further Far Eastern deployment in 1969 she was chosen to perform the McDonnell Douglas F-4 Phantom trials for the Royal Navy, and in the following year embarked her first ASW helicopter squadron. Her career was tragically cut short in the early 1970s by the political decision that it would be too costly to convert her to full-time Phantom operations (in fact only minimal changes were required) and she became yet another victim of the 1966 Labour government. She paid off in January 1972 and effectively became the floating spares platform for the *Ark Royal*, finally being towed away for scrap in 1978. By the time she was paid off her air group had again been reduced, this time to 30 fixed- and six rotary-wing aircraft, these being Buccaneers, Sea Vixens, Gannet AEW.Mk 3s and Wessexes.

Specification

HMS *Eagle*
Displacement: 44,100 tons standard and 45,100 tons full load
Dimensions: length 247.4 m (811.75 ft); beam 34.4 m (112.7 ft); draught 11.0 m (36.0 ft); flight deck width 52.1 m (171.0 ft)
Propulsion: four-shaft geared steam turbines delivering 113346 kW (152,000 shp)
Speed: 31.5 kts
Aircraft: 36-60 (see text)
Armament: four twin 114-mm (4.5-in) DP guns, and six quadruple GWS22 Sea Cat SAM launchers
Complement: 2,750
Electronics: one Type 984 3D radar, one Type 965 air-search radar, one Type 963 CCA landing aid, one Type 974 navigation radar and one ESM system

Eagle in Action

HMS **Eagle** *was the logical extension of the wartime 'Implacable' class of carriers, but in her lifetime was to see many of the changes that swept through carrier design in the 1950s. For many years the Royal Navy's spearhead, she saw action at Suez and in the Indian Ocean in the 1960s.*



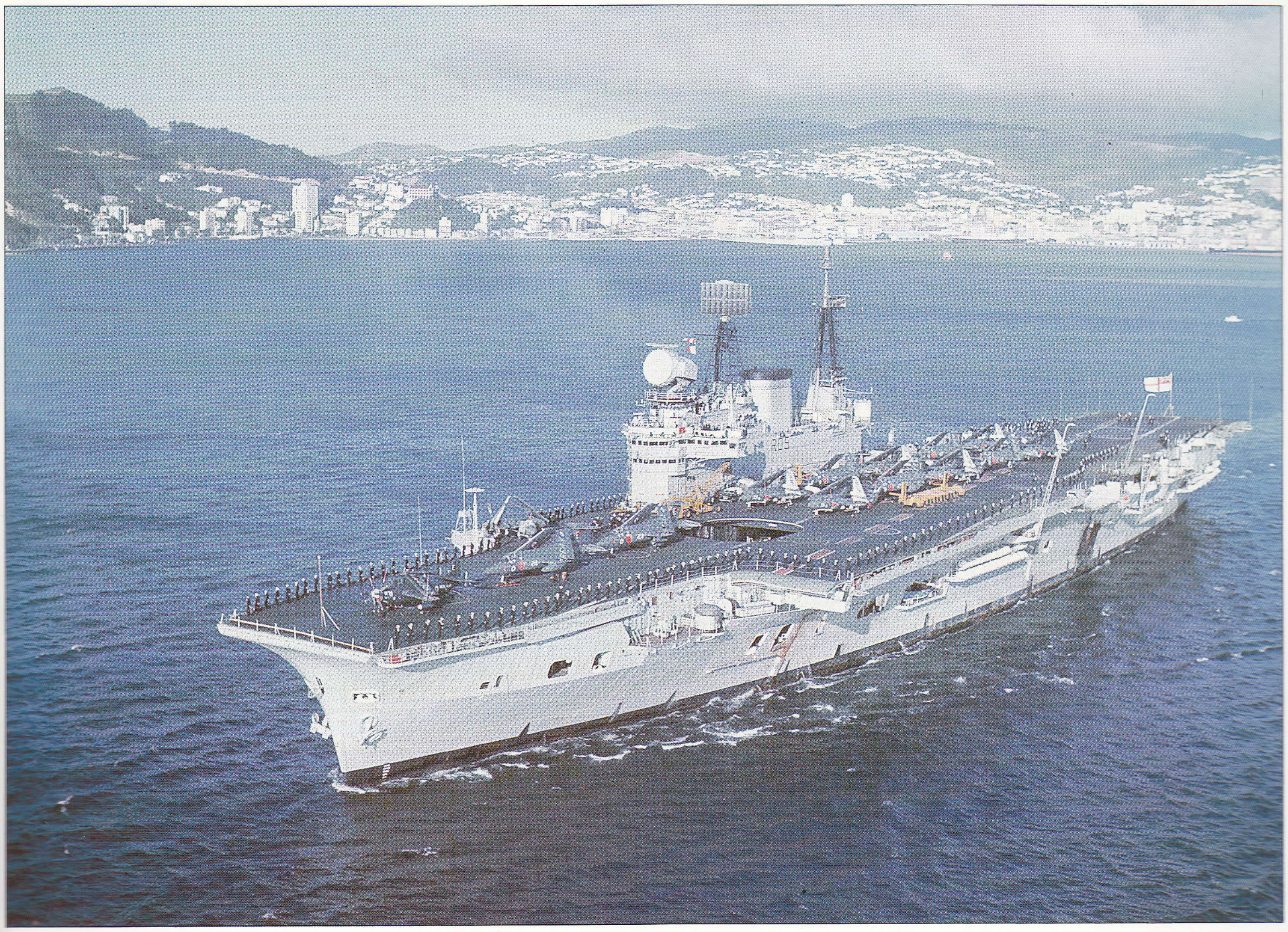
The Buccaneer S.Mk 1 equipped No. 800 Sqn, formed in March 1964 for service aboard HMS **Eagle**. *These early Buccaneers were painted in overall 'anti-flash' white, an anti-nuclear measure.*

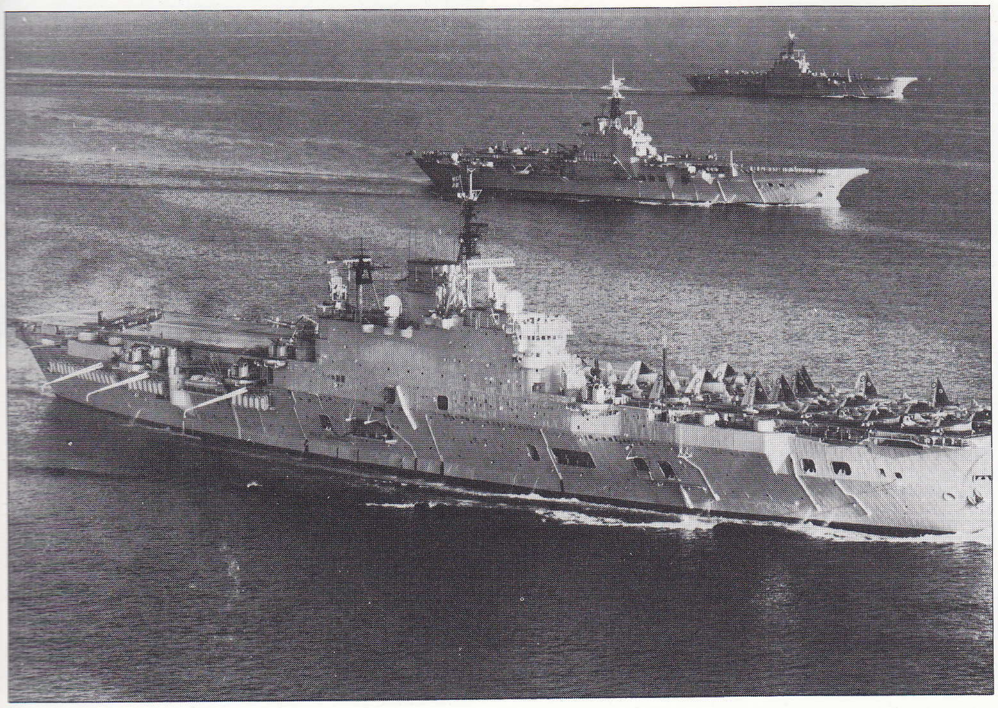
Although overshadowed in the latter part of her career by her near sister HMS *Ark Royal*, HMS *Eagle* was for many years one of the Royal Navy's primary strike carriers. In the mid-1960s she underwent a refit to operate the latest naval strike aircraft, the Blackburn Buccaneer, and was by the spring of 1966 on station off East Africa enforcing the Rhodesian oil blockade as part of the thankless Beira patrol. In the following year she was sent to the waters off Aden during the withdrawal period, there teaming with the other carriers HMS *Hermes* and *Victorious*, the Commando carriers *Albion* and *Bulwark*, and the assault ships *Intrepid* and *Fearless* to form the biggest force of major warships the Royal Navy had assembled east of Suez since the Korean War. Apart from the Buccaneers the carrier air group embarked also included a squadron of de Havilland Sea Vixen F(AW).Mk 2 twin-boom jet fighters. The early warning element was provided by a flight of Fairey Gannet AEW.Mk 3s, whilst a small number of Supermarine Scimitar F.Mk 1s in a single flight provided inflight-refuelling facilities with buddy packs. A couple of helicopters were also embarked for SAR duties.

Tactically the Buccaneers were intended to operate below the detection limits of enemy air-search radars, approaching the target at high subsonic speeds to deliver their weapon loads either by toss-bombing in the case of the internally carried 'Red Beard' tactical nuclear weapon or by more conventional dive or lay-down modes with 227-kg (500-lb) and 454-kg (1,000-lb) HE ballistic bombs, and 51-mm (2-in) or 76-mm (3-in) unguided rockets. Missile attacks could also be performed using wing-mounted radio-guided Martin AGM-12B Bullpups, and photo-reconnaissance missions were possible with a special camera pack mounted in the bomb bay.

The two-seater Sea Vixen's main armament comprised two retractable fuselage packs each housing 14 51-mm unguided rockets plus various weapons on each of the four inner underwing pylons such as a Firestreak or Red Top IR-guided AAM, a 24-round 51-mm rocket pod, a 227-kg HE bomb or a cluster of six

Seen leaving Wellington, New Zealand, in the late 1960s, **Eagle** *could always be distinguished from her half-sister* **Ark Royal** *by the massive Type 984 radar atop her bridge, and the absence of catapult bridles (extensions).*

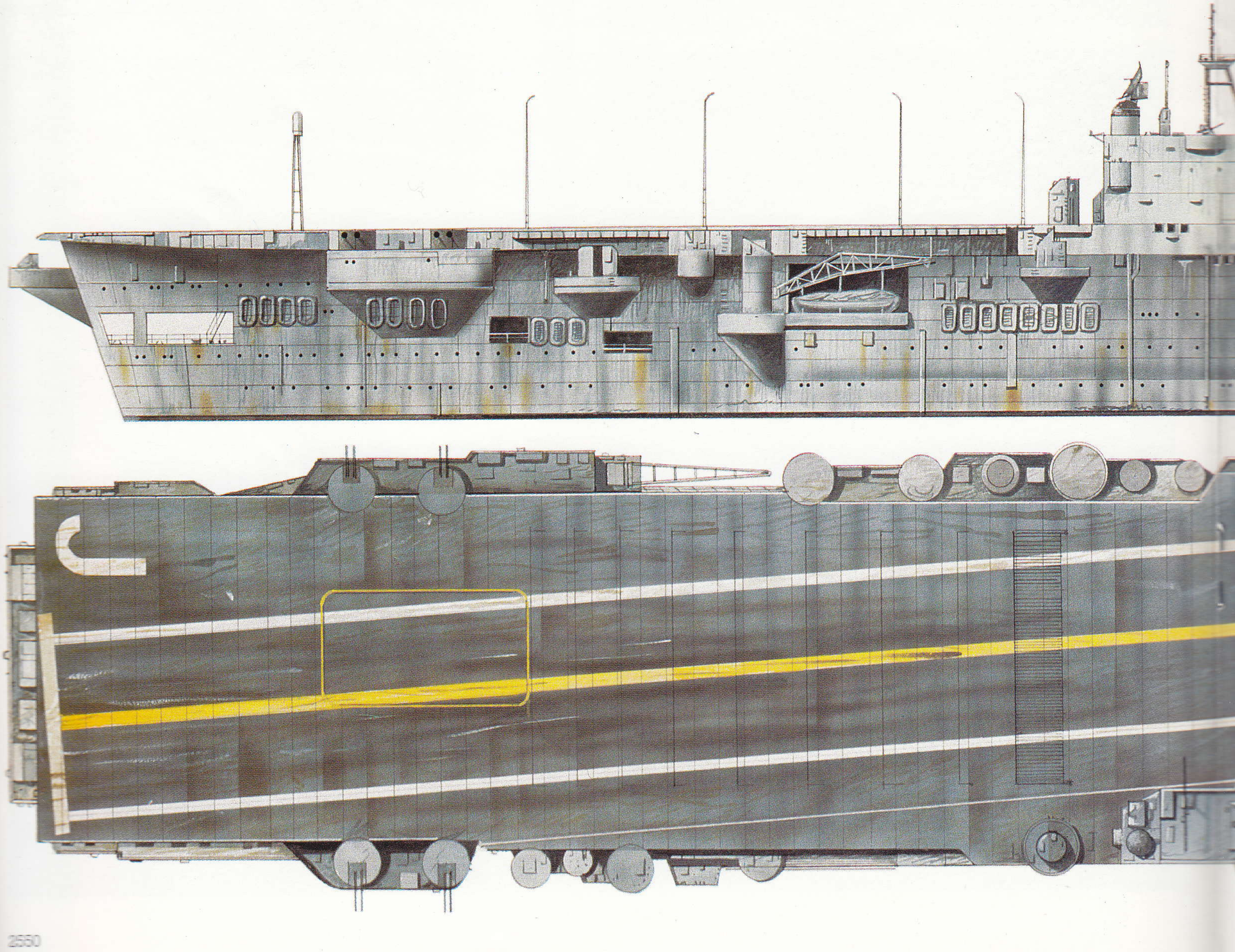




76-mm rockets. The two larger outer pylons usually carried a 682-litre (150-Imp gal) fuel tank, though tthese could be replaced by either a 454-kg HE bomb or an AGM-12A Bullpup missile if required.

To launch such aircraft required, as it still does, an elaborate ritual of checks and tests over a fairly long period by a highly trained crew. Whilst the aircrew is getting dressed for the mission the aircraft is subjected to a 'before flight inspection' plus any additional tests/checks deemed necesssary. If in the hangar the aircraft is then moved to the flight deck by the aircraft lift, where it is parked for the aircrew to board and start their pre-launch checks. When these tests have been satisfactorily completed, the brakes are released and the aircraft is carefully taxied under its own power to the designated catapult in response to the directions of the yellow-coated flight deck directors. Once there, the mainwheels are lined up over the catapult groove by in-

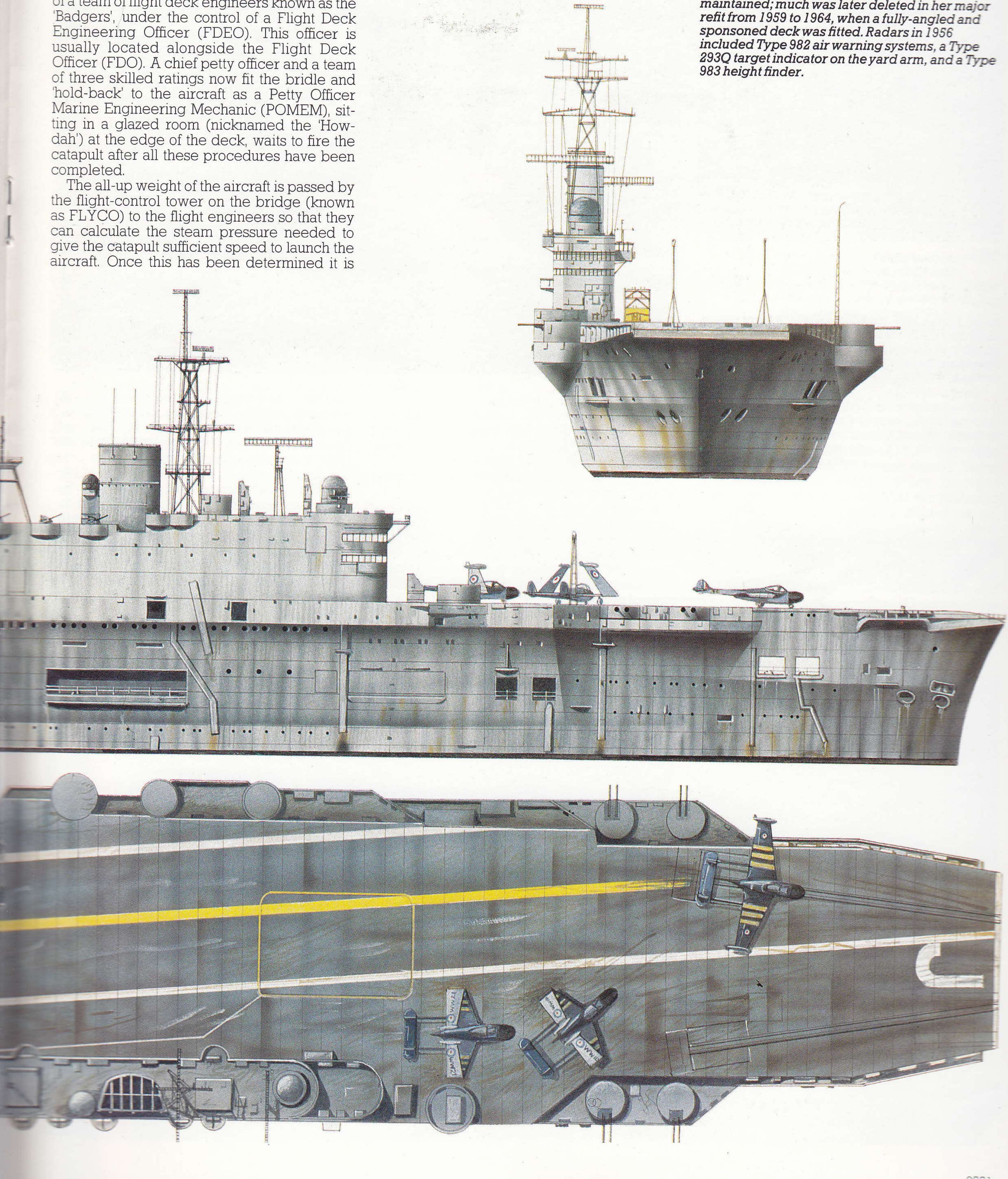
October 1956, and HMS** Eagle, **the flagship of Vice Admiral Manley Power, leads HMS** Bulwark **and HMS** Albion **on exercise off Malta. Within weeks, they were to be heavily involved in support of the Suez landing.



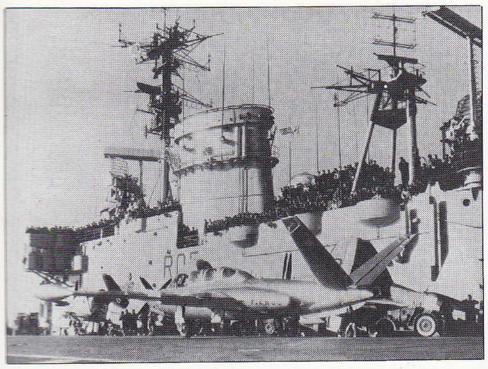
ching the plane forward until it meets a set of retractable chocks for the wheels.

At this point the aircraft passes to the control of a team of flight deck engineers known as the 'Badgers', under the control of a Flight Deck Engineering Officer (FDEO). This officer is usually located alongside the Flight Deck Officer (FDO). A chief petty officer and a team of three skilled ratings now fit the bridle and 'hold-back' to the aircraft as a Petty Officer Marine Engineering Mechanic (POMEM), sitting in a glazed room (nicknamed the 'Howdah') at the edge of the deck, waits to fire the catapult after all these procedures have been completed.

The all-up weight of the aircraft is passed by the flight-control tower on the bridge (known as FLYCO) to the flight engineers so that they can calculate the steam pressure needed to give the catapult sufficient speed to launch the aircraft. Once this has been determined it is



HMS ***Eagle*** ***as she appeared at Suez in 1956; during her 1954/5 refit she had received a 5.5° angled deck. Note the heavy gun armament still maintained; much was later deleted in her major refit from 1959 to 1964, when a fully-angled and sponsoned deck was fitted. Radars in 1956 included Type 982 air warning systems, a Type 293Q target indicator on the yard arm, and a Type 983 height finder.***



A Fouga CM.170M Magister Marine of the French Aéronavale makes a first touch down on the deck of HMS Eagle*, during a 1959 series of deck landing trials conducted in conjunction with the French navy.*

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Right: Spring 1966, and Eagle *is on the Beira patrol, enforcing the blockade of Rhodesia following the colony's Unilateral Declaration of Independence. Some months later she would be further north, covering Britain's 1967 withdrawal from Aden.*

passed to the POMEM, who calls the below-deck control panel in the catapult department to verify that sufficient pressure will be available. The FLYCO informs the aircrew of the actual launch speed relative to the minimum required, and this is then used by the crew to calculate the tailplane trim settings necessary for the launch, and they set this on their controls. The actual angle set is checked by a member of the deck crew, who confirms it to the pilot via a printed message on a card with the observed setting on it. At the same time two other deck crewmen are working beneath the aircraft, one fitting the armament safety breaks and the other plugging in a lead from the ship's inertial navigation system to align the aircraft gyros. Once this is done the aircraft observer visually confirms this to the deck crew.

The white wedge of the catapult shuttle is then moved back to a point beneath the aircraft to assume the ready position, and two members of the catapult crew attach the heavy wire strop bridle between the aircraft and the grooved end of the shuttle. At a signal from the catapult chief to the 'Howdah', the shuttle is eased forward to tension the bridle and haul the aircraft back onto its tail skids, so giving the aircraft its characteristic launch position and thus reasonable wing angle of attack. As the bridle is fitted the hold-back is also attached aft into the catapult groove to ensure that the combined power of the aircraft's engines and the catapult are applied instantaneously and in the right amount.

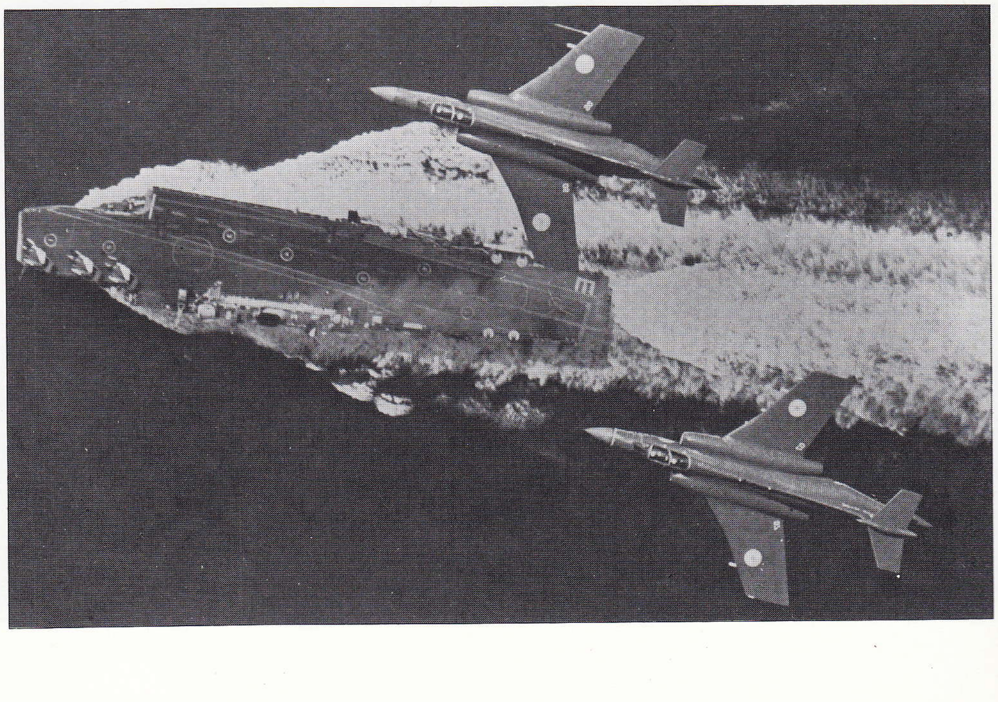
Ready to launch

Once both operations are completed the catapult chief hands over the launch to the FDO, who then raises a visual green flag signal to the pilot to indicate that he is to commence his final cockpit checks and increase engine power to full. On completion of the checks the pilot indicates by hand or head movements whether he is satisfied or not. If it is the latter the launch is abandoned and the aircraft released from the catapult. However, if everything is satisfactory the FDO makes a final check that the catapult track is free of obstructions and that the catapult itself is in a launch condition. He then lowers his flag slowly to the deck. At this point the duty planeguard SAR helicoper (with diver and winchman standing by) moves in close to make a final visual check of the whole scene, and then moves back to a position some 46 m (50 yards) to port but clear of the launch itself.

In the 'Howdah' the POMEM sees the FDO's signal and lowers his hands (previously kept in plain view of all the men working around the aircraft) down to the launch firing button. As he depresses it the catapult operation is initiated and the aircraft is dragged down the deck along the catapult track. At the end of the track the bridle comes to an abrupt halt to be saved by a special strop-catching device, and the aircraft is launched skywards to climb away.

Landing the aircraft is equally involved, requiring a number of specialist devices and personnel. Three modes of recovery are used: Type 1, which is visual all the way to the Deck Landing Projector Sight and used in perfect weather conditions; Type 2, which is radar-assisted to a visual circuit; and Type 3, which is the Carrier-Controlled Approach and uses special radar and voice communciation techniques in adverse weather conditions to bring the aircraft down. Once aboard, the aircraft's arrester hook engages a hydraulically tensioned wire stretched across the deck to bring the aircraft to a full stop. Within seconds of this the aircraft is folding its wings and the Flight Deck Marshal is directing it towards its allotted parking space for the crew to get out and the aircraft to be refuelled and rearmed, or for the aircraft to be struck down into the hangar for more extensive maintenance.

Two Buccaneers overfly HMS Eagle *on deployment in the late 1960s after the addition of a waist catapult. At this late stage of a 20-year career her displacement had risen from 45,720 tons in 1951 to a maximum of 54,100 tons.*



USA

'Essex' class SCB-27A reconstructions

At the end of World War II in 1945 the US Navy had what was in essence an obsolescent carrier force as it could not operate the coming generation of jet aircraft. Although a follow-on carrier design was completed in 1946 it was not built, and the US Navy had thus to adopt the policy of reconstructing its **'Essex' class** carriers that had been laid up in reserve. The first programme, known as **SCB-27A**, was actually used as the basis to complete the hull of the USS **Oriskany** (CV-34). As built she lacked the flight deck guns of her predecessors, but the most powerful hydraulic catapults were fitted and the flight deck itself was considerably strengthened. The island superstructure was rebuilt to improve radar coverage, and a considerable internal rearrangement was made to enhance habitability and survivability. Eight other vessels, the USS ***Essex*** (CV-9), ***Yorktown*** (CV-10), ***Hornet*** (CV-12), ***Randolph*** (CV-15), ***Wasp*** (CV-18), ***Bennington*** (CV-20), ***Kearsage*** (CV-33) and ***Lake Champlain*** (CV-39), were then refitted to this standard. Later all but the *Lake Champlain* were given angled flight decks and enclosed bows.

Over the years most of the gun armament was removed and the radar systems changed. As rebuilt the ships carried 1135620 litres (300,000 US gal) of Avgas and 725 tons of aircraft ordnance (including 125 tons of nuclear weapons). As more modern carriers entered service so the SCB-27As were switched to ASW operations with Grumman S-2 Trackers and helicopters. Many of these ships (CVS-9, 10, 12, 15, 18, 20 and 23) underwent FRAM ASW modernizations in the 1960s in a programme which included the fitting of an SQS-23 bow sonar and a partially automated ASW-orientated Command Information Center. Several of these ASW carriers served tours off Vietnam as screening units to attack units. The air group normally comprised 30 fixed-wing aircraft and 16-18 Sikorsky Sea King ASW helicopters. The *Essex, Kearsage, Oriskany* and *Lake Champlain* also saw service off Korea during that war in the conventional attack role.

Specification

'Essex SCB-27A' class

Displacement: 28,404 tons standard and 40,600 tons full load

Dimensions: length 273.8 m (898.2 ft); beam 30.9 m (101.3 ft); draught 9.1 m (29.7 ft); flight deck width (angled) 59.7 m (196.0 ft)

Propulsion: four-shaft geared steam turbines delivering 111855 kW (150,000 shp)

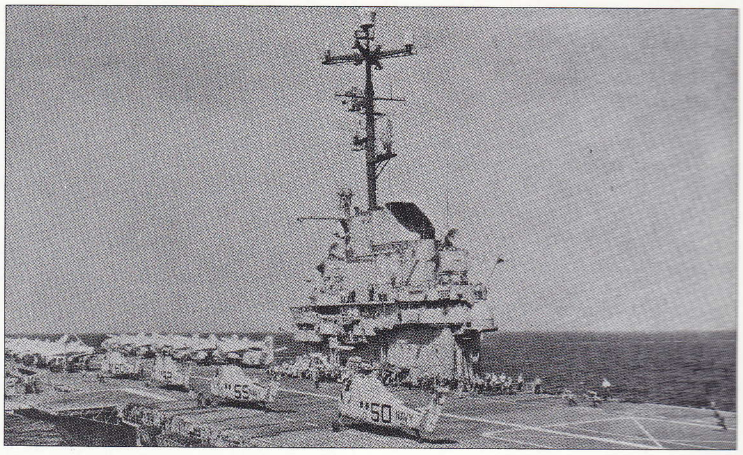
Speed: 30 kts

Armament: eight single 127-mm (5-in) and 14 twin 76-mm (3-in) AA guns, later reduced to two or four single 127-mm guns

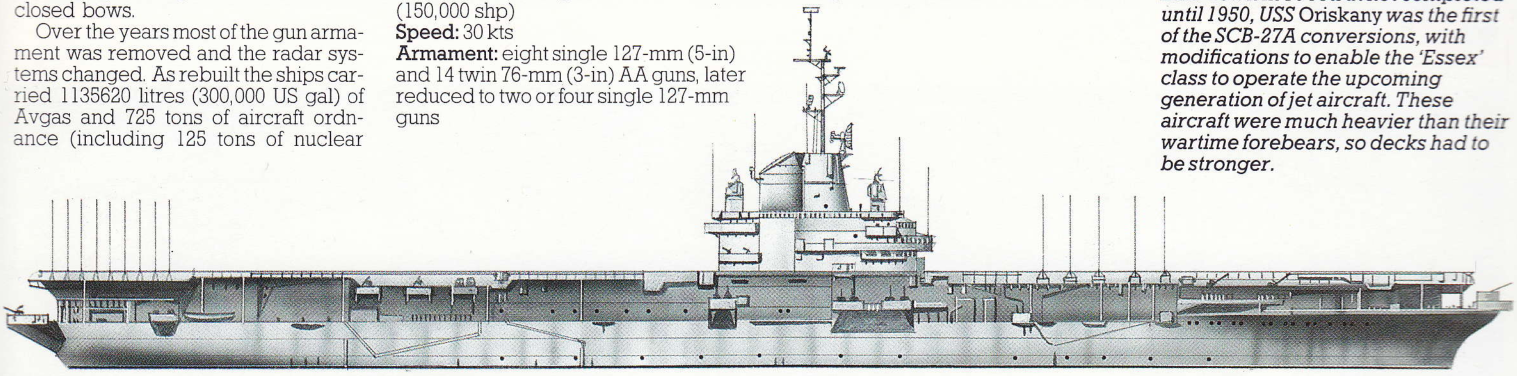
Aircraft: 45-80 (see text)

Complement: 2,900

Electronics: one SPS-6 (later SPS-12 then SPS-29) air-search radar, one SPS-8 (later SPS-30) height-finding radar, one SPS-10 surface-search radar, and (FRAM ASW conversions) one SQS-23 bow sonar.



Sikorsky HSS-1 Seabats aboard the SCB-27A conversion USS Lake Champlain *(CVS-39) in the late 1950s. The modification entailed tidying up the island and removal of the 5-in (127-mm) flight deck gun mounts.*



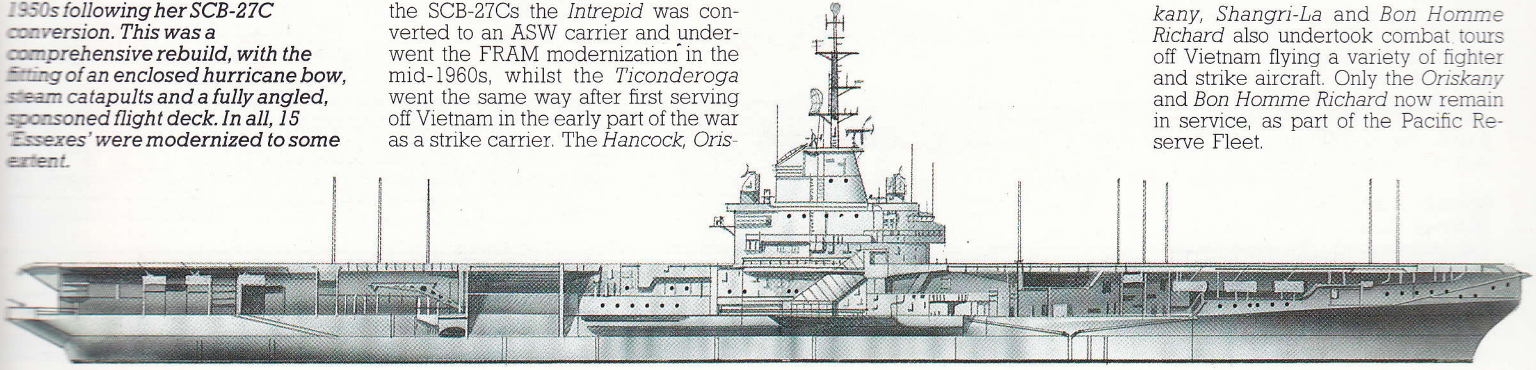
Laid down in 1944 but not completed until 1950, USS Oriskany *was the first of the SCB-27A conversions, with modifications to enable the 'Essex' class to operate the upcoming generation of jet aircraft. These aircraft were much heavier than their wartime forebears, so decks had to be stronger.*

USA

'Essex' class SCB-27C reconstructions

Once the SCB-27A refit programme was under way it soon became apparent that the advances in carrierborne aircraft technology demanded even more alterations, and thus the **SCB-27C** programme was born. Three ships, namely the USS ***Intrepid*** (CV-11), ***Ticonderoga*** (CV-14) and ***Hancock*** (CV-19), were so converted in 1951-4 with two steam catapults, revised aircraft lift arrangement and enhanced arrester gear. A further three units to be converted, the ***Lexington*** (CV-16), ***Bon Homme Richard*** (CV-31) and ***Shangri-La*** (CV-38), were then chosen to be refitted to the follow-on **SCB-125** standard, which involved the reconfiguration of the flight deck to an angled landing area and the reshaping of the island superstructure. All three units were out of dock by late 1955 by which time all the SCB-27Cs, except the *Lake Champlain* of the SCB-27As and the *Oriskany*, were undergoing or had undergone similar conversions. Of the SCB-27Cs the *Intrepid* was converted to an ASW carrier and underwent the FRAM modernization in the mid-1960s, whilst the *Ticonderoga* went the same way after first serving off Vietnam in the early part of the war as a strike carrier. The *Hancock, Oriskany, Shangri-La* and *Bon Homme Richard* also undertook combat tours off Vietnam flying a variety of fighter and strike aircraft. Only the *Oriskany* and *Bon Homme Richard* now remain in service, as part of the Pacific Reserve Fleet.

In the Gulf of Tonkin in 1971, an F8 Crusader overflies the USS* Hancock. *Unlike many of the 'Essex' class, she continued as a front-line carrier throughout her career. The Vietnam War saw* Hancock *on station for lengthy periods during the 1960s. She was decommissioned in 1976.



USS Shangri La *as she was in the late 1950s following her SCB-27C conversion. This was a comprehensive rebuild, with the fitting of an enclosed hurricane bow, steam catapults and a fully angled, sponsoned flight deck. In all, 15 'Essexes' were modernized to some extent.*

Specification

'Essex SCB-27C' class
Displacement: 30,580 tons standard and 43,060 tons full load
Dimensions: length 272.6 m (894.5 ft); beam 31.4 m (103.0 ft); draught 9.2 m (30.3 ft); flight deck width 58.5 m (192.0 ft)
Propulsion: four-shaft geared steam turbines delivering 111855 kW (150,000 shp)
Speed: 29 kts
Armament: four single 127-mm (5-in) DP guns
Aircraft: 70-80
Complement: 3,545
Electronics: one SPS-8 (later SPS-37A and SPS-30) height-finding radars, one SPS-12 surface-search radar and one ESM system

USS* Intrepid *as an ASW carrier in the Atlantic in 1971. She saw action in World War II, suffering many* kamikaze *attacks. After remodernization, she made three tours off Vietnam, before decommissioning in 1974. She is now preserved as a museum in New York.

USA

'Midway' class

Originally to have numbered six units, the **'Midway' class** suffered the cancellation of three units but entered the post-war years as the only American carriers capable of operating without modification the new generation of heavy attack aircraft. Even so it was soon found that a refit was needed in the middle to late 1950s to accommodate all recent carrier innovations. The USS *Midway* (CVB-41) and USS *Franklin D. Roosevelt* (CVB-42) were rebuilt under the **SCB-110** programme with two steam catapaults, the angled flight deck of the SCB-27Cs and a 'hurricane bow', whilst the last unit, the USS *Coral Sea* (CVB-43), received the **SCB-110A** modification which was a somewhat more extensive refit that included the fitting of a third steam catapult in the waist position. By the mid-1960s it was thought necessary for the three vessels to undergo yet another rebuild, and the *Midway* was taken in hand in the latter part of the decade for an **SCB-101.66** refit to allow her to accommodate the latest generation of carrier aircraft. However, the final cost proved so great that the *Franklin D. Roosevelt* ended with only an austere version of SCB-101.66 in 1968 whilst the *Coral Sea*, having had the SCB-110A improvement, was deemed sufficiently modern to remain in service unaltered. As the vessel in the worst material condition, the *Franklin D. Roosevelt* was stricken in 1977 and broken up, but the other two remain in operational service. All three served off Vietnam during the war there. Under the SCB-110/110A refits provision was made for 1,376 tons of ordnance, 134760 litres (35,600 US gal) of Avgas and 2271240 litres (600,000 US gal) of JP-5 aircraft fuel.

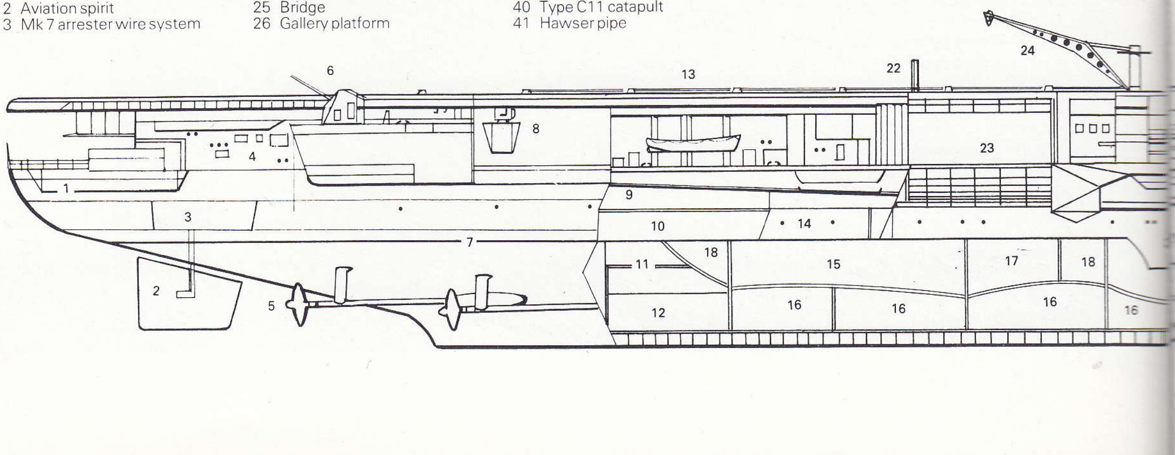
Specification

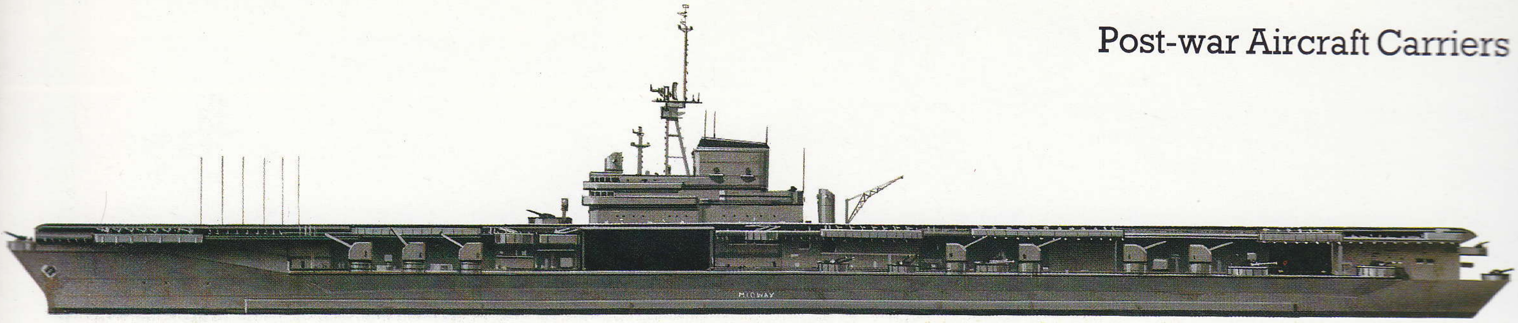
'Midway' class
Displacement: 42,710 tons standard and 62,614 tons full load
Dimensions: length 298.4 m (979.0 ft); beam 36.9 m (121.0 ft); draught 10.8 m (35.3 ft); flight deck width 72.5 m (238.0 ft)
Propulsion: four-shaft geared steam turbines delivering 158088 kW (212,000 shp)
Speed: 30.6 kts
Aircraft: 70-80
Armament: 10 single 127-mm (5-in) DP and nine twin 76-mm (3-in) AA guns
Complement: 4,060
Electronics: one SPS-12 surface-search radar, one SPS-8 height-finding radar and one SPS-10 surface-search radar; more modern equipment was added over the years

The commissioning of the* Franklin D. Roosevelt *occurred at a time when a carrier was still expected to fight off air attack by gun power. The 'Midway' class was designed for an air group of some 140 aircraft of World War II type, and this size was to stand them in good stead in the jet age.

US *Coral Sea* 'Midway' class aircraft carrier, mid-1960s

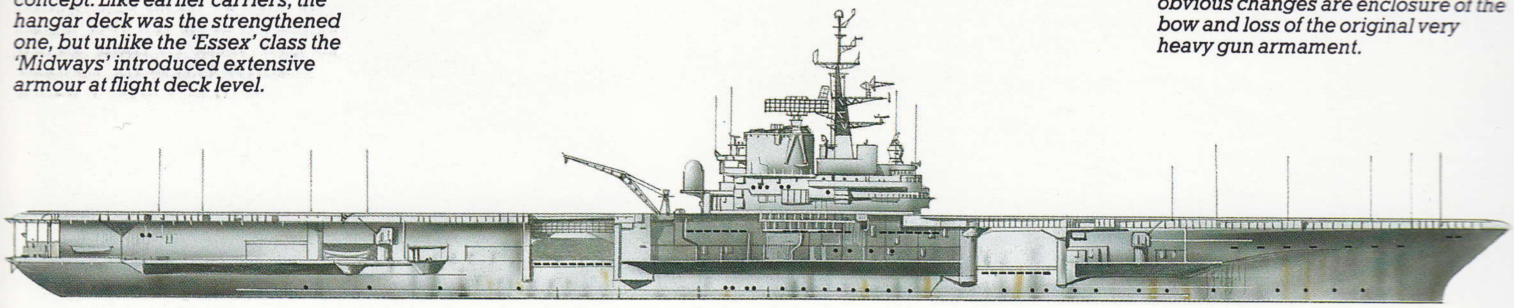
1 CPO area
2 Balanced rudder
3 Steering compartment
4 Aviation spares/repair shops
5 Screw
6 5-inch/54 dual-purpose gun
7 Waterline
8 5-inch gun fire control system
9 Air crew
10 Stores
11 Ammunition
12 Aviation spirit
13 Mk 7 arrester wire system
14 Crew area
15 Engine room
16 Boiler room
17 Ship's service turbo generator
18 Pump room
19 Auxiliary machine room
20 Double bottom
21 Former position of armour belt
22 Frensel deck landing mirror
23 53-ton deck edge lift
24 Aircraft crane
25 Bridge
26 Gallery platform
27 Mast
28 Funnel
29 SPS-43 radar
30 SPS-30 radar
31 Air defence position
32 Navigation bridge
33 Flag bridge
34 Control centre
35 Ventilators
36 Flying deck
37 Hangar
38 Wing compartments
39 Fuel tanks
40 Type C11 catapult
41 Hawser pipe
42 Capstan
43 Anchor
44 Mooring ring
45 Hawser reel
46 Chain locker
47 Forefoot
48 Officer's quarters
49 Walkway
50 Bomb stowage magazine



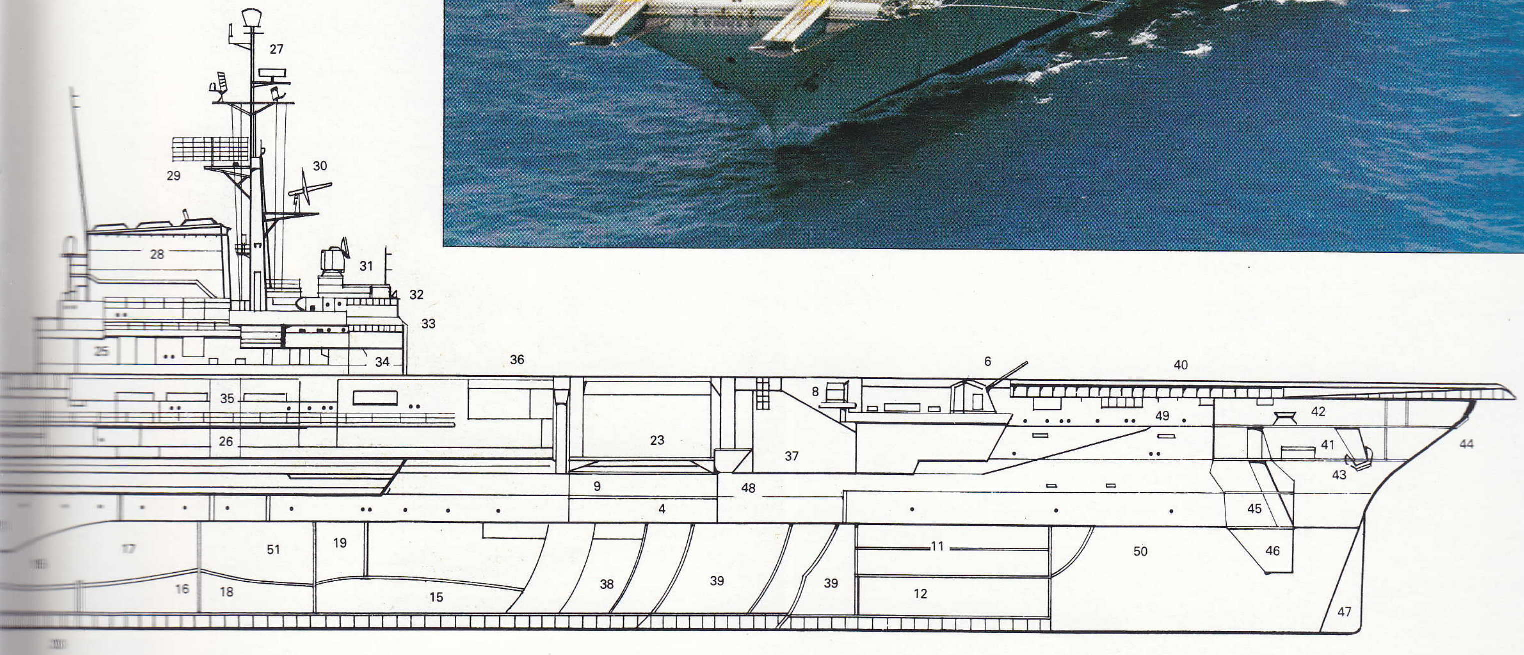


Above: Commissioned in the last week of World War II, USS Midway *was the ultimate expression of the 'add-on hangar and flight deck' concept. Like earlier carriers, the hangar deck was the strengthened one, but unlike the 'Essex' class the 'Midways' introduced extensive armour at flight deck level.*

Below: Thirty years separate the two profiles of USS Midway, *and in those years the ship's fighting power has grown enormously. The most obvious changes are enclosure of the bow and loss of the original very heavy gun armament.*



Right: Most thoroughly modernized of the class, USS Midway *will remain a deployable carrier until the turn of the century. In her active life of over 55 years, it may be true to say that she will have experienced a more dramatic enhancement of her capability than any ship in history.*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Evolution of the Carrier

The end of World War II had seen the aircraft carrier firmly in place as the most powerful component of modern navies. The rapid advance in jet propulsion was to represent a major threat to that importance, however, and until the carrier could handle the increased size and speed of the new aircraft, naval aviation was to lag behind its land-based counterpart.

The landing of the first jet aircraft aboard the British carrier HMS *Ocean* in late 1945 heralded a new era for the aircraft-carrier. In order to meet the requirements of jet-propelled aircraft a number of innovations were henceforth incorporated into old and new designs in the 1950s and 1960s. By far the most important of these was the angled flight deck. The high landing speeds of jet aircraft entailed comparatively long landing runs, and considerations of safety dictated that such runs be angled away from the longitudinal axis of the flight deck. The resultant change in the shape of the deck not only removed the possibility of aircraft collisions during a landing but also at a stroke allowed both the opportunity for more attempts to be made and, more importantly, the capability for the carrier to launch aircraft from its bow catapults while landings were being made on the angled deck. This re-arrangement of flight deck activities in the 1950s effectively produced three flight deck areas (the angled landing strip, the take-off position forward and a triangular deck parking area for aircraft between the other two areas) that have characterized all carriers since, with the notable exception of those specificlly equipped for V/STOL operations.

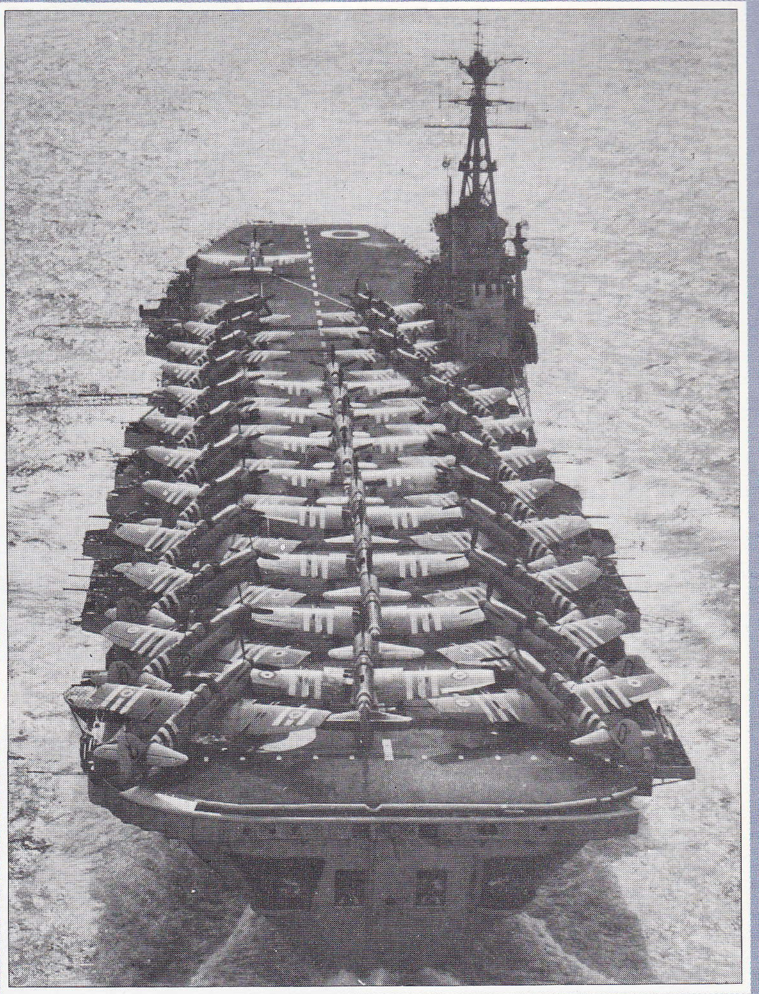
At the same time that the flight deck revolution occurred, it was realized that something more potent than a hydraulic catapult was needed to launch the jets. Following trials (again aboard a British carrier, HMS *Perseus*) in 1950, the solution universally adopted was the steam (slotted cylinder) catapult which actually took up less space and was much lighter in relation to its power output than its hydraulic predecessors. It is the size of the steam catapult (and hence its operating capacity in terms of the load that can be accelerated satisfactorily) which today influences to a considerable degree the physical parameters and hence ultimate cost of a carrier design. For instance a carrier must be able to perform a number of missions which in turn usually requires several different types of aircraft of different sizes (and by implication weights) to fulfil them. Thus in order to launch these aircraft, catapults of sufficient power and length are needed, and these catapults occupy a certain proportion of the flight deck which thus becomes unavailable for any other activities. For the US Navy's Grumman F-14 Tomcat air-defence fighter, weighing in at 33725 kg (74,350 lb) fully loaded, the minimum catapult length required is in the order of 76 to 91 m (250 to 300 ft) so it rapidly becomes apparent why the US Navy has built a preponderance of 'super-carriers'.

Deck landing aids

The problems associated with poor landing approaches to the carrier deck were also resolved by replacing the human deck landing control officer with deck landing aids that could be seen at a considerable distance by an incoming pilot, who could thus judge for himself whether or not his approach altitude was correct. The old concept of a safety barrier for damaged aircraft landings, using low-slung steel wires, was also abandoned for the use of nylon safety nets with vertically aligned strops that literally absorb the energy of the incoming airframe and bring it to a sudden stop without additional damage. In contrast, the use of the arrester wire continued, although in a much more powerful hydraulically-operated form to cope with the heavier jet aircraft.

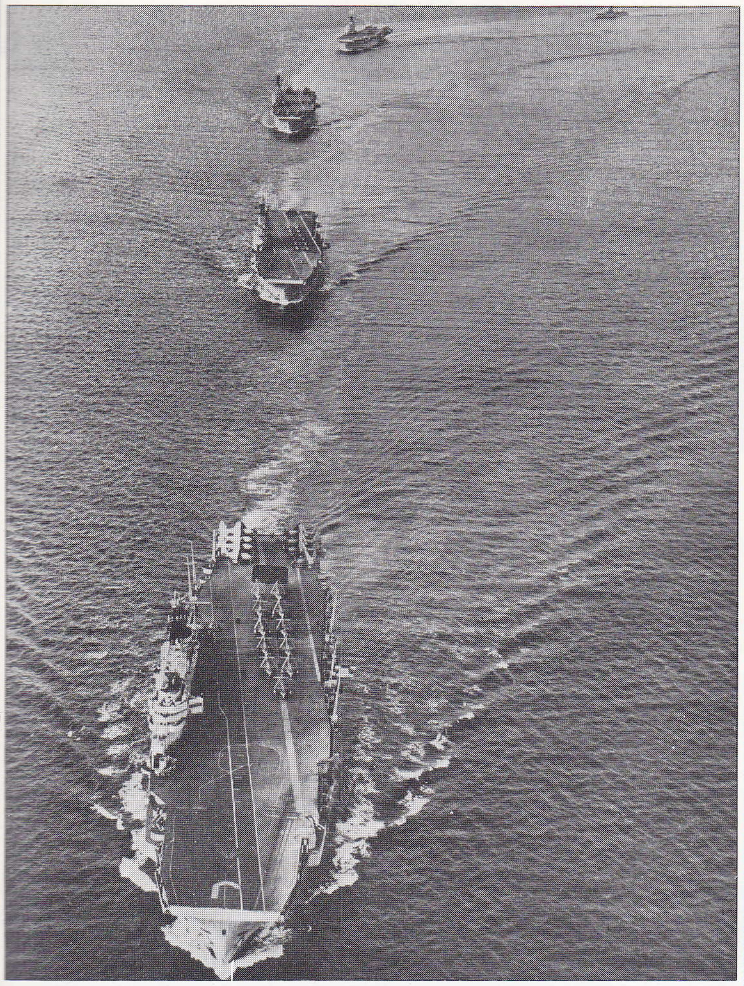
Internally the arrangements have for many years been dependent on the user navy and where the carrier is expected to operate. The Royal Navy has, for example, long taken the view that the below-decks hangar should be an enclosed box-like structure that should be capable of taking the entire aircraft complement, thus effectively limiting the total number of aircraft embarked. At the same time all servicing and repairs are also performed within this structure, which means that every available piece of space is utilized for machinery and stores. In contrast, the US Navy's philosophy has been that hangars should be relatively open to reduce the danger from explosions and that part of the air group should be permanently carried on deck, thus increasing markedly the number of aircraft carried in relation to a British carrier. The switch of the US carrier force from fossil fuel to nuclear propulsion has also allowed for far higher tonnages of aviation ordnance and fuel to be carried, so extending the time spent on operations. Although not able for various reasons to match the Americans, the Royal Navy countered by introducing into service the world's first V/STOL carrier, which allows for aircraft operations in conditions hitherto thought improbable for fixed-wing aircraft. The almost continuous availability of BAe Sea Harriers to the Task Force during operations in the Total Exclusion Zone during the 1982 Falklands war is a testament to this capability. The latest addition to the V/STOL carriers is the 'ski-jump' ramp to increase the payload of the aircraft operating in the short take-off mode.

For the future it would appear that smaller navies, like that of the UK, will concentrate on the V/STOL carrier types, whilst the two big superpower navies (those of the USA and USSR) plus that of France are going to continue with the conventional fixed-wing type but with nuclear propelled carriers to increase their capabilities. The USSR is relatively new to this concept and has relied on its 'Moskva' class helicopter cruisers and the 'Kiev' class V/STOL carriers to provide experience in the carrier field.

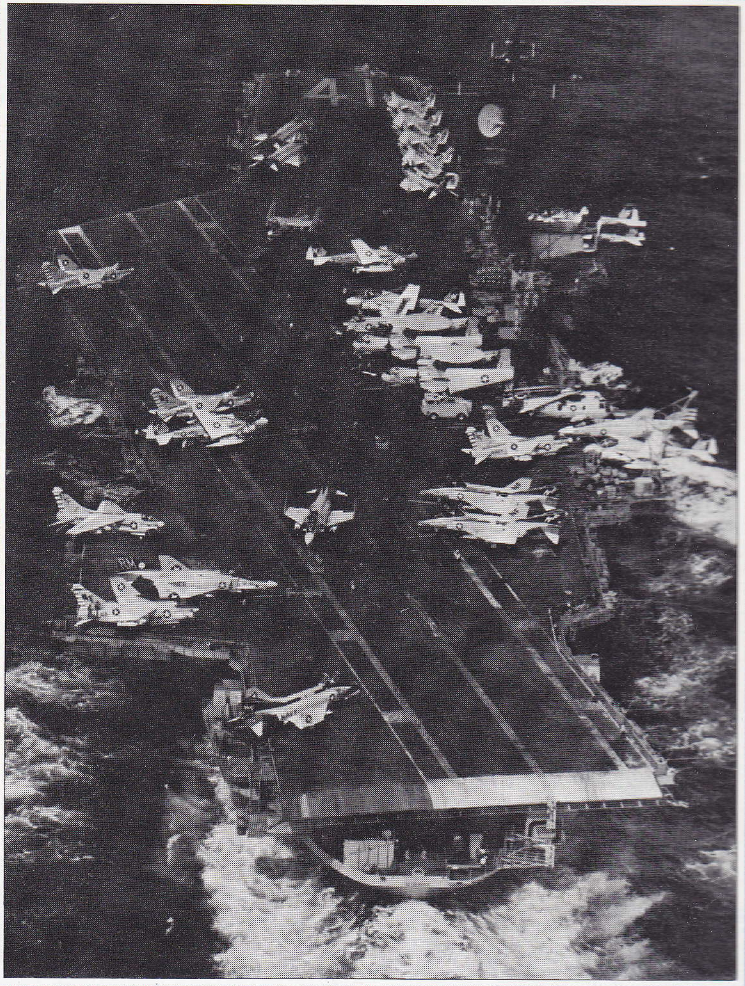


HMS Ocean, on her way to Korea, presents the classic through deck of the World War II carrier. It is obvious that while aircraft are parked on deck, landing operations would be impossible as any overshoot would plough into machines farther up the deck.

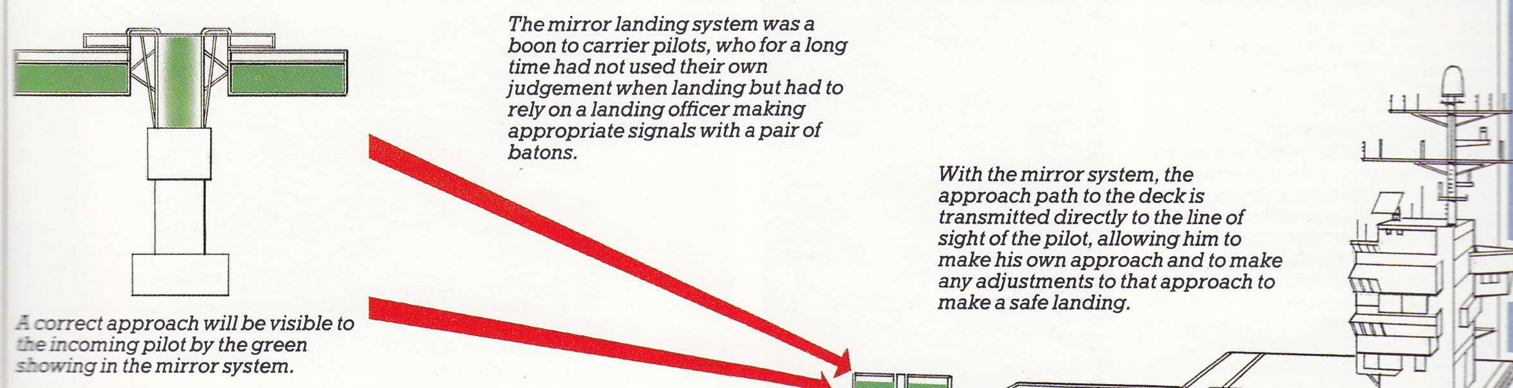
A McDonnell Douglas F-4 Phantom launches from the waist catapult of HMS Ark Royal. The powerful steam catapult was the only way in which such heavy aircraft (more than 20 tons) could be regularly operated.



Royal Navy carriers in the Mediterranean in 1960 display the first aspect of the angled deck. By diverting the approach some 5°, landing aircraft had a completely unobstructed touchdown path.



The final stage in development of the angled deck, USS Midway *displays the three aircraft-handling areas of a modern deck. Between the angled landing deck and the launching area forward is a triangular space available for aircraft parking.*



The mirror landing system was a boon to carrier pilots, who for a long time had not used their own judgement when landing but had to rely on a landing officer making appropriate signals with a pair of batons.

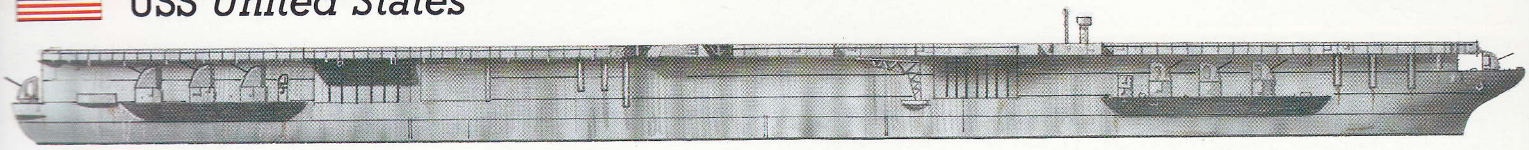
With the mirror system, the approach path to the deck is transmitted directly to the line of sight of the pilot, allowing him to make his own approach and to make any adjustments to that approach to make a safe landing.

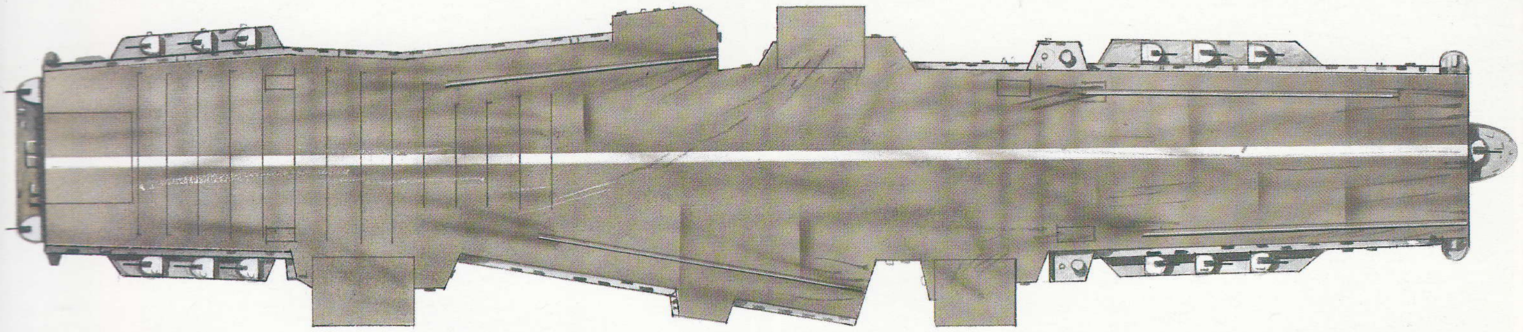
A correct approach will be visible to the incoming pilot by the green showing in the mirror system.

An incorrect approach is visible to the incoming pilot by red (too low) or white (too high) showing.

USA

USS *United States*





Although cancelled only nine days after her keel had been laid down in April 1949, the USS ***United States*** (CVA-58) is included here because she was the predecessor of the 'Forrestal' class and its successors, and because by virtue of her advanced design she had a profound effect on future development. She was designed to operate a new generation of US Navy heavy strategic bombers (in the 25/45-ton class) and their attendant escort fighters. Because of the size of the bombers the flight deck had to be large enough both to park them and to fly them on and off. In the end an armoured and completely flush-deck configuration was chosen with four catapults: two at the bows, and one each to port and starboard in complementing amidships positions and angled outwards to clear the aircraft forward. Four deck-edge lifts were also to be fitted (one to port, two to starboard and one at the stern). The aviation fuel capacity was to be a massive 1892700 litres (500,000 US gal), and the ordance load 2,000 tons. Four vessels were to have been built, the later ones nuclear-powered. No major electronics were carried as the escorting warships were expected to take care of this work. The cancellation of the ship was due mainly to its projected role, for the US Air Force objected vigorously to the US Navy duplicating its strategic mission. The funds released were ploughed back to the US Air Force to increase its bomber fleet.

Specification

USS *United States*

Displacement: 66,850 tons standard and 83,249 tons full load

Dimensions: length 331.6 m (1,088.0 ft); 38.1 m (125.0 ft); draught 10.5 m (34.5 ft); flight deck width 57.9 m (190.0 ft)

Propulsion: four-shaft geared steam turbines delivering 208796 kW (280,000 shp)

Speed: 33 kts

Armament: eight single 127-mm (5-in) DP, eight twin 76-mm (3-in) AA and 20 single 20-mm AA guns

Aircraft: 18 bombers and 54 McDonnell F2H Banshee fighters

Complement: 4,127

Electronics: one SPS-6 air-search radar and one SPS-8 height-finding radar

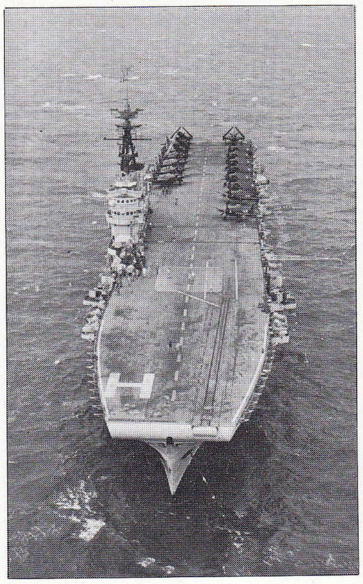
The startling lines of the USS United States *design were a result of the fact that early atomic bombs were heavy pieces of equipment, requiring large aircraft, which in turn required large amounts of fuel. To that end, the* United States *was dedicated solely to the operation of these aircraft and their escorting fighters.*

FRANCE

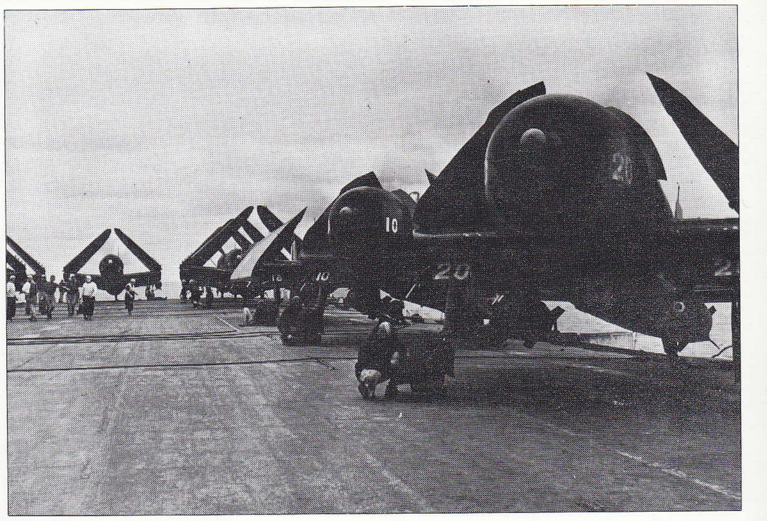
FNS *Arromanches*

Laid down in June 1942 and launched in September 1943 as the British **'Colossus' class** carrier HMS ***Colossus***, this ship was loaned to the French navy in August 1946 (after 12 months of service in the Far East) for a five-year period. As FNS ***Arromanches*** (R95) she made two combat deployments to French Indo-China, flying Douglas SBD Dauntless divebombers and Supermarine Seafire Mk XV fighters on the first, and 24 Grumman F6F Hellcat fighters and Curtiss SB2C Helldiver divebombers on the second. She was finally purchased outright in 1951 when the loan expired, and was sent on two more Indo-China deployments before the French defeats of 1954. Transferred to the Mediterranean, the *Arromanches* took part in the 1956 Anglo-French Suez landings with Vought F4U Corsairs and Grumman TBM Avengers against targets around Port Said.

In 1957-8 the ship underwent a complete rebuild in which she received a 4° angled flight deck and a mirror landing aid. The AA armament then com-

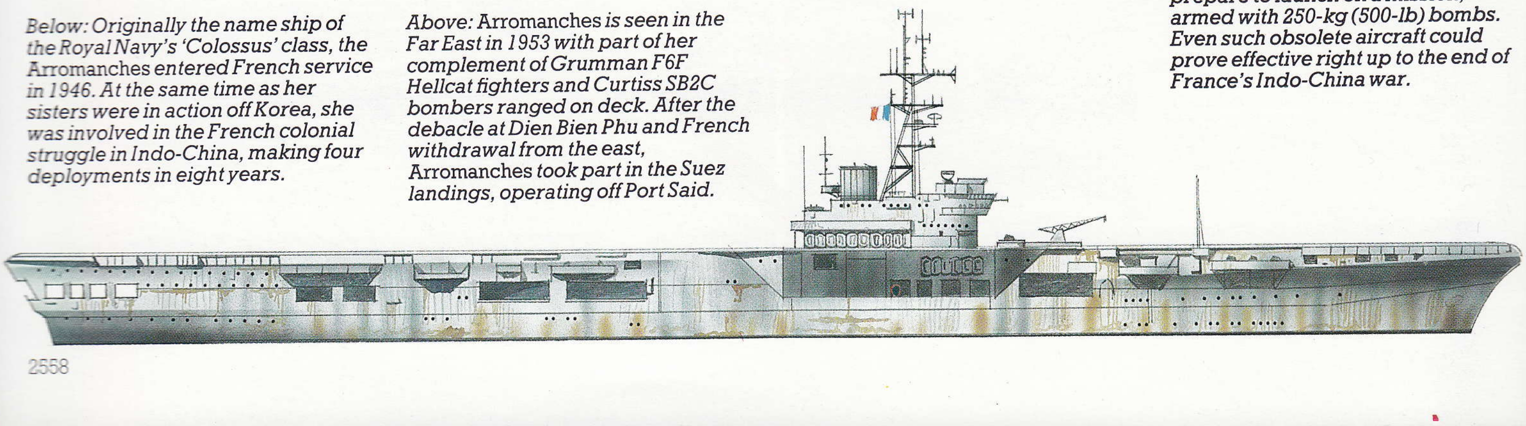


Above: Arromanches *is seen in the Far East in 1953 with part of her complement of Grumman F6F Hellcat fighters and Curtiss SB2C bombers ranged on deck. After the debacle at Dien Bien Phu and French withdrawal from the east,* Arromanches *took part in the Suez landings, operating off Port Said.*



Above: Aboard Arromanches *off Saigon, F6F-5s of Flottille 11F prepare to launch on a mission, armed with 250-kg (500-lb) bombs. Even such obsolete aircraft could prove effective right up to the end of France's Indo-China war.*

Below: Originally the name ship of the Royal Navy's 'Colossus' class, the Arromanches *entered French service in 1946. At the same time as her sisters were in action off Korea, she was involved in the French colonial struggle in Indo-China, making four deployments in eight years.*



prised 43 40-mm guns instead of the original armament of 24 2-pdr and 19 40-mm guns. By the early 1960s all of the 40-mm guns had been removed and the *Arromanches* had been relegated to the training carrier role flying both Breguet Alizé ASW aircraft and the navalized version of the Magister jet trainer, the Fouga CM175M Zéphyr, to produce personnel for the air groups of the new carriers *Foch* and *Clemenceau*. In 1962 the *Arromanches* also took on the assault role when a squadron of Sikorsky HSS-1 helicopters was embarked. After a further refit in 1968 to carry an air group of 24 helicopters she was redesignated as a helicopter carrier with ASW, transport, training and intervention missions tasked to her as required. Finally decommissioned in 1974, the *Arromanches* was broken up at Toulon in 1978.

Specification
FNS *Arromanches*
Displacement: 14,000 tons standard and 19,600 tons full load
Dimensions: length 211.84 m (695.0 ft); beam 24.38 m (80.0 ft); draught 7.16 m (23.5 ft); flight deck width 36.0 m (118.0 ft)
Propulsion: two-shaft geared steam turbines delivering 29828 kW (40,000 shp)
Speed: 25 kts
Armament: see text
Aircraft: 24 (see text)
Complement: 1,400
Electronics: one DRBV 22A air-search radar, plus various French, American and British radars and aircraft landing aids

NETHERLANDS

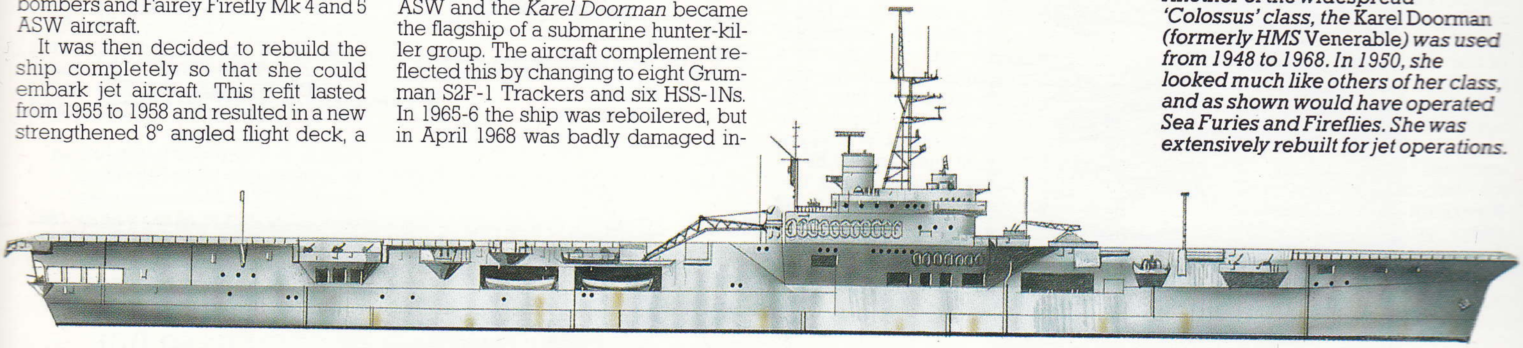
HMNS *Karel Doorman*

Laid down in December 1942 and launched one year later, the British light fleet carrier HMS ***Venerable***, of the **'Colossus' class**, was completed in January 1945 in time to see limited service in the Far East as part of the 11th Carrier Squadron in mopping-up operations after the Japanese surrender. She was sold to the Royal Netherlands Navy in 1948 and was given the same name, HMNS ***Karel Doorman*** (R81), as the former British escort carrier (ex-HMS *Nairana*) she replaced. By 1950 she was operating an air group of 19 Hawker Sea Fury FB.Mk 11 fighter-bombers and Fairey Firefly Mk 4 and 5 ASW aircraft.

It was then decided to rebuild the ship completely so that she could embark jet aircraft. This refit lasted from 1955 to 1958 and resulted in a new strengthened 8° angled flight deck, a steam catapult to port forward, a mirror landing sight, strengthened aircraft lifts and a new type of arrester gear. The island superstructure was also rebuilt with a new mast, Dutch radars and a taller funnel, whilst the armament was reduced from its original enhanced 34 40-mm guns to 12 single 40-mm guns. The air group then typically comprised six Hawker Sea Hawk FGA.Mk 6 jet fighters, six Grumman TBM-3 Avenger ASW aircraft, four Sikorsky HSS-1N Seabat ASW helicopters and two utility helicopters. By the early 1960s the emphasis had shifted to ASW and the *Karel Doorman* became the flagship of a submarine hunter-killer group. The aircraft complement reflected this by changing to eight Grumman S2F-1 Trackers and six HSS-1Ns. In 1965-6 the ship was reboilered, but in April 1968 was badly damaged internally by a boiler room fire. She was subsequently sold to the Argentine navy, which had her refitted in the Netherlands before accepting her into service as ARA ***Veinticinco de Mayo*** in October 1968. She is still extant in 1986.

Specification
HMNS *Karel Doorman*
Displacement: 15,892 tons standard and 19,896 tons full load
Dimensions: length 211.29 m (693.2 ft); beam 24.38 m (80.0 ft); draught 7.47 m (24.5 ft); flight deck width 25.91 m (85.0 ft)
Propulsion: two-shaft geared steam turbines delivering 29828 kW (40,000 shp)
Speed: 23.5 kts
Aircraft: see text
Complement: 1,462
Electronics: one LW-02 air-search radar, one LW-01 air-search radar, one DA-01 combined air-surface-search radar, one VI-01 height-finding radar and one ZW-01 navigation radar

Another of the widespread 'Colossus' class, the Karel Doorman *(formerly HMS* Venerable*) was used from 1948 to 1968. In 1950, she looked much like others of her class, and as shown would have operated Sea Furies and Fireflies. She was extensively rebuilt for jet operations.*



ARGENTINA

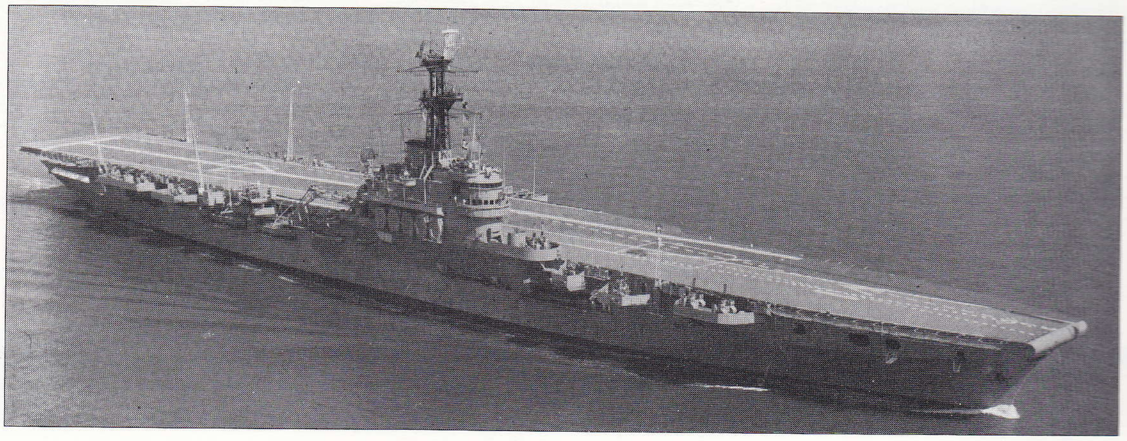
ARA *Independencia*

ARA ***Independencia*** (V1) was launched in May 1944 as the British **'Colossus' class** carrier HMS ***Warrior*** (R31) and lent to the Royal Canadian Navy on completion in 1945 for a period of two years until the Canadian carrier HMCS *Magnificent* was ready for service. On return from the Canadians she was used by the Royal Navy for deck landing trials and in 1948-9 was fitted with a flexible landing deck to allow jet fighters with skid-type landing gear to make soft landings. In 1952-3 the ship was fitted with a new enlarged bridge and a lattice foremast, whilst in 1955 she was revised with 5° angled flight deck and stronger arrester gear. Following more deck landing trials work with this new configuration, she was tasked in 1957 to act as the HQ ship for Operation 'Grapple' (the British H-bomb test programme) at Christmas Island in the Pacific.

On her return the ship was offered for sale to Argentina. The deal was signed in the summer of 1958, and the ship sailed under her new name in December of that year for Argentina. As transferred she carried only 12 40-mm AA guns, a number reduced to eight shortly afterwards. However, by May 1962 she was spotted with a new battery of one quadruple and nine twin 40-mm guns. In August of the following year she embarked the first jet fighter type of the Aviacion Naval, the Grumman F-9F Panther. By this time she was also carrying piston-engined Vought F4U-5 Corsair fighter-bombers and the Grumman TF-9J Cougar operational jet trainer. North American T-28 Trojan piston-engined trainers (in the form of the French Fennec armed version) were also a common sight aboard the *Independencia*. By the end of the ship's career in the late 1960s the embarked air group was made up of six Grumman S-2A Tracker ASW aircraft and 14 Fennecs. In 1970, following the acquisition of ARA *Veinticino de Mayo*, the *Independencia* was placed in reserve, finally being sold for scrap in early 1971.

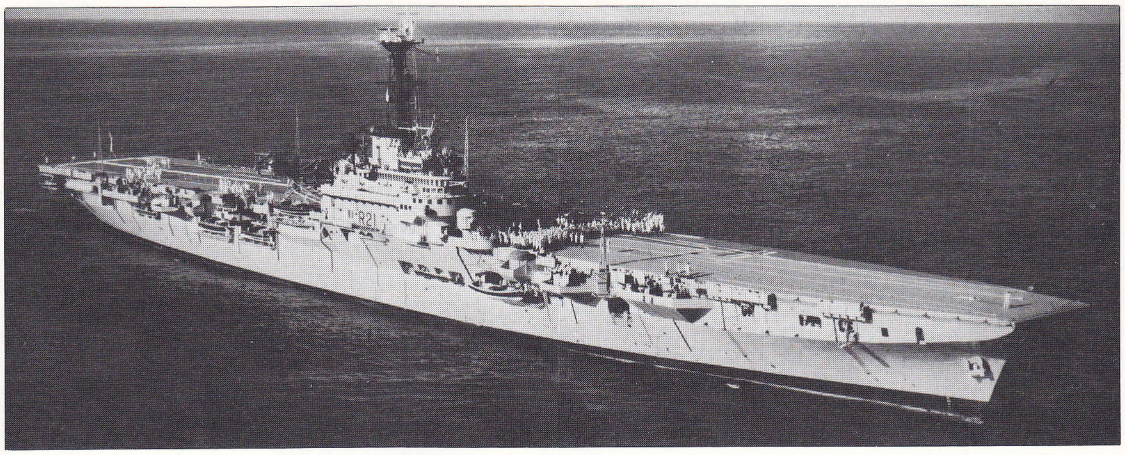
Specification
ARA *Independencia*
Displacement: 14,000 tons standard and 19,540 tons full load
Dimensions: length 211.84 m (695.0 ft); beam 24.38 m (80.0 ft); draught 7.16 m (23.5 ft); flight deck width 22.86 m (75.0 ft)
Propulsion: two-shaft geared steam turbines delivering 29828 kW (40,000 shp)
Speed: 24.3 kts
Armament: one quadruple and nine twin 40-mm AA guns
Aircraft: 24 (see text)
Complement: 1,575
Electronics: not known

Originally the British 'Colossus' class carrier HMS Warrior*, the Argentine carrier* Independencia *had a varied career, serving in Korea as well as being lent to the Canadian navy before being acquired in 1958. Among the aircraft types operated were F4U Corsairs and Grumman F9F Panthers.*



AUSTRALIA

HMAS *Melbourne*



Work on all six of the Royal Navy's **'Majestic' class** carriers was stopped after the end of World War II. However, because of interest expressed by the Royal Australian and Canadian navies in acquiring carriers, two units were subsequently completed as HMS *Terrible* (bought by the Australians as HMAS *Sydney*) and *Magnificent* (loaned to the Canadians under that name), whilst work on a third, HMS ***Majestic***, was started in 1948 to a greatly modified configuration with 25 40-mm AA guns, a 5.5° angle landing deck, new arrester gear, a mirror landing sight system and a steam catapult. The opportunity to fit a greatly enhanced radar suite was also taken, with no fewer than three Type 277Q height-finding sets, a Type 293 surface-search set and a Type 978 navigation set.

Recommissioning as HMAS ***Melbourne*** (R21) in October 1955, the carrier embarked an air group of eight de Havilland Sea Venom jet fighters, 12 turboprop-engined Fairey Gannet ASW aircraft and two Bristol Sycamore SAR helicopters. In 1963-7 the *Melbourne* served as the RAN flagship, and her air group was reduced to four Sea Venoms, six Gannets and 10 Westland Wessex HAS.Mk 31B helicopters. In late 1967 the ship was taken in hand for strengthening of the decks, lifts, catapult and arrester gear, the fitting of new radar and communications equipment and the reduction of the AA armament numbers. This was to allow for the carriage and operation of American Douglas A-4G Skyhawk attack aircraft and Grumman S-2E Tracker ASW aircraft. The new radars were a mixture of Dutch and American types, together with the old Type 293 and Type 978 sets. The air group now consisted of four Skyhawks, six Trackers and the 10 Wessex helicopters, though from 1972 onwards it was again changed to eight Skyhawks, six Trackers and 10 Westland Sea King HAS.Mk 50 ASW helicopters plus two or three Wessex helicopters in the SAR/planeguard role. After a final refit in 1976 it was announced that the *Melbourne* was to serve on until 1985, but as a result of financial constraints she was paid off into reserve during June 1982, and in 1984 was sold for scrap. Although a replacement was scheduled (including at one stage the Royal Navy's *Invincible*), it now seems that this is a forlorn hope especially as all navy fixed-wing aircraft have now been sold or transferred to the Royal Australian Air Force.

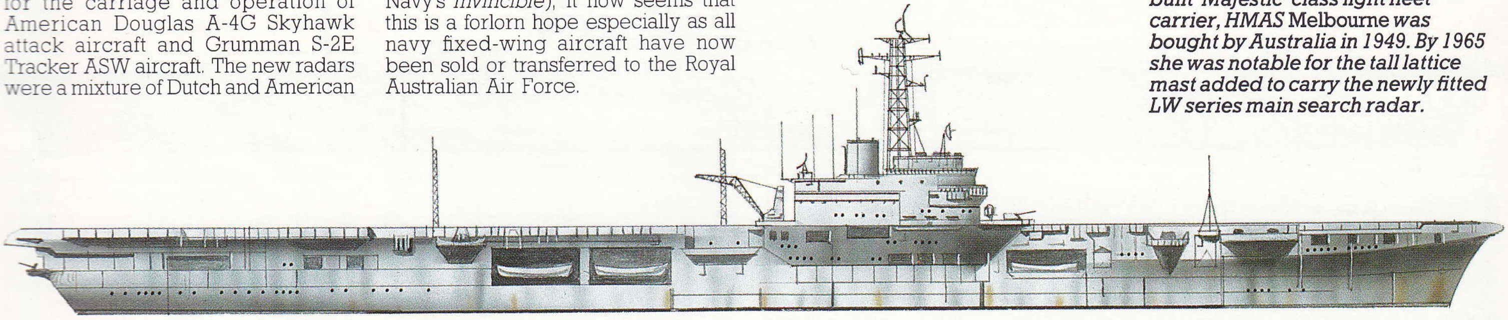
Specification

HMS *Melbourne*
Displacement: 16,000 tons standard and 20,320 tons full load
Dimensions: length 213.82 m (701.5 ft); beam 24.38 m (80.0 ft); draught 7.62 m (25.0 ft); flight deck width 32.0 m (105.0 ft)
Propulsion: two-shaft geared steam turbines delivering 31319 kW (42,000 shp)
Speed: 23 kts
Armament: four twin and four single 40-mm AA guns
Aircraft: 27 (see text)

HMAS** Melbourne **is seen entering Pearl Harbor in June 1958. Her air group at this time comprised 27 aircraft including Sea Venoms and ASW Gannets. She was flagship of the Royal Australian Navy, and remained so until her withdrawal from service in 1982.

Complement: 1,425 (as flagship)
Electronics: one LW-02 air-search radar, one Type 293Q surface-search radar, one Type 978 navigation radar, one SPN-35 landing aid radar, one TACAN system and one ECM system

Formerly name ship of the British built 'Majestic' class light fleet carrier, HMAS** Melbourne **was bought by Australia in 1949. By 1965 she was notable for the tall lattice mast added to carry the newly fitted LW series main search radar.



CANADA

HMCS *Bonaventure*

The British **'Majestic' class** aircraft-carrier ***Powerful*** was laid down in November 1943 and launched in an incomplete state in February 1945. In 1952 the hulk was purchased by the Royal Canadian Navy as HMCS ***Bonaventure*** (RML22) and redesigned before her completion to accommodate an 8° angled flight deck, a steam catapult, modern arrester gear and a stabilized mirror landing sight. She was also fitted with four twin 76-mm (3-in) AA guns on four sponsons projecting from the hull sides. The island was rebuilt and a tall lattice mast with US radars erected in place of the original tripod model. Entering Canadian fleet service in 1957 (with pennant number RSM22) the *Bonaventure* had an air group consisting initially of 16 McDonnell F2H Banshee jet fighters and eight Canadian-built Grumman CS-2F Tracker ASW aircraft. In 1961 it was changed to an all-ASW force with eight Trackers and 13 Sikorsky HO4S-3 Whirlwind helicopters. The latter were finally replaced by Sikorsky CHSS-2 Sea Kings when they became available. The *Bonaventure*'s mid-life (and last) major refit in 1966-7 saw the fitting of new Dutch radar and the Fresnal landing aid, the removal of the two forward gun sponsons in order to enhance the ship's sea-keeping qualities, and improvements in the accommodation, aircraft handling and anti-fallout protection facilities. The *Bonaventure* (now CVL22) was finally paid off in 1970 for disposal because of the costs of keeping her in service. She was subsequently sold and broken up for scrap.

Specification

HMCS *Bonaventure*
Displacement: 16,000 tons standard and 20,000 tons full load
Dimensions: length 214.82 m (704.8 ft); beam 24.38 m (80.0 ft); draught 7.62 m (25.0 ft); flight deck width 32.0 m (105.0 ft)
Propulsion: two-shaft geared steam turbines delivering 29828 kW (40,000 shp)
Speed: 24.5 kts
Armament: four (later two) twin 76-mm (3-in) Mk 33 AA guns
Aircraft: 21-24 (see text)
Complement: 1,370
Electronics: (before 1967-8 refit) one SPS-12 air-search radar, one SPS-8 height-finding radar and SPS-10 surface-search radar

The uncompleted 'Majestic' class carrier HMS** Powerful **was sold to Canada and completed as HMCS** Bonaventure**. Although originally equipped with McDonnell F2H Banshees, by 1961 she had become an ASW-dedicated vessel. By 1968 she appeared as shown, with new Dutch radars and with improved sea-keeping.